1-1-1994

Demonstration Of Dissimilar Simulator Networking

University of Central Florida Institute for Simulation and Training

INSTITUTE FOR SIMULATION AND TRAINING

Contract Number N61339-91-C-0103
STRICOM
CDRL A003
July 14, 1994

Demonstration of Dissimilar Simulator Networking

DISTRIBUTED INTERACTIVE SIMULATION
INDUSTRY
GOVERNMENT
ACADEMIA
DIS

PREPARED FOR:
U.S. Army Simulation Training and
Instrumentation Command
12350 Research Parkway
Orlando, Florida 32826

IST

Institute for Simulation and Training
3280 Progress Drive
Orlando FL 32826

University of Central Florida
Division of Sponsored Research

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1. INTRODUCTION

The large-scale use of distributed, computer-based simulations began with the Simulator Networking project (SIMNET) initiated by the Defense Advanced Research Projects Agency (DARPA) in the early 1980's. By the end of that decade the utility and training effectiveness of the technology had been proven. At that time DARPA and the Army initiated the formal structuring of an open architecture for the conduct of networked simulations. The approach taken brought the Institute for Simulation and Training (IST) into the role of leading bi-annual open workshops, with industry, government and academic participants engaging in the development of Standards for the conduct of Distributed Interactive Simulation (DIS).

The use of a large conference such as the Interservice/Industry Training Systems and Education Conference (I/ITSEC) to bring a large number of participants together into a structured experiment in the use of DIS was first employed at the I/ITSEC conference at San Antonio, Texas in 1992. The experience gained and lessons learned from that experiment were valuable in supporting the successful balloting that led to the adoption of the first generation IEEE Standard 1278 for DIS. With this successful experience to draw from, and encouraged by the increasing maturity of the developing new draft Standards and importance placed on DIS technology by the DoD, a similar undertaking was agreed to for the 1993 Conference. For brevity, this effort will be referred to as IDEMO93 (I/ITSEC demonstration 1993).

The I/ITSEC Conference offers some unique opportunities for conducting DIS related experiments in that it is multi-service, defense related and draws both corporate and government organization participation. In this climate there exist unique opportunities to bring together a multitude of diverse, non-homogeneous simulators and simulations to observe their ability to co-exist and/or interoperate on a common network with common data-bases, using the most recent version of the DIS Standard.

1.1 ABBREVIATIONS AND ACRONYMS

AAR	After Action Review
ARP	Address Resolution Protocol
ATST	Program for Address Resolution Testing
AUSA	Association of the United States Army
CGF	Computer Generated Forces
DEC	Digital Equipment Corporation
DIS	Distributed Interactive Simulation protocol standard
DoD	Department of Defense
DoDDS	Department of Defense Dependent Schools
DSI	Defense Systems Internet
ESPDU	Entity State Protocol Data Unit
FHL	Fort Hunter-Liggett
I/ITSEC	Interservice/Industry Training Systems and Education Conference
IDA	Institute for Defense Analyses
IDEMO	I/ITSEC Demonstration
IEEE	Institute for Electrical and Electronics Engineers
IG	Image Generator
IST	Institute for Simulation and Training
LAN	Local Area Network
NAWC/TSD	Naval Air Warfare Center/Training Systems Directorate
PC	Personal Computer
PDU	Protocol Data Unit
PVD	Planview Display
SAF	Semi-Automated Forces
SIMAN	Simulation Management protocol
SIMNET	Simulator Network protocol standard
STRICOM	U.S. Army Simulation Training and Instrumentation Command
SUT	System Under Test
TDB	Terrain Database
UTST	Program for UDP Testing
WAN	Wide Area Network

2. PURPOSE AND SCOPE

The purpose of this report is to describe the processes used to prepare for the demonstration and to support its conduct as well as the activity at the conference site itself. It will describe actions, processes and equipment that worked well as well as some to be avoided. The report covers the period beginning with the initial planning, which started in January 93 through the last demonstration and follow-up activities in December 93.

2.1. BACKGROUND

The form and content of the Application Level Protocol Data Unit (PDU) structures have continued to evolve since IEEE 1278 was adopted as a standard. From the experience at San Antonio the community learned important lessons about how a network should be set up and managed and how participants should come prepared to participate. With the new features being incorporated in version 2.0.3 of the PDU Draft Standard it seemed prudent to evaluate the performance of the draft version in a demanding, real-world environment.

IST proposed to coordinate the planning and organization of the exercise for the US Army's Simulation Training and Instrumentation Command (STRICOM) as it related to ongoing research. In turn, the Defense Modeling and Simulation Office (DMSO) agreed to support the effort, both financially and through its influence with industry. Preliminary planning began in January 1993 for the event which was to occur at the end of November. Even with this lead time, an extremely intense effort was required during the final weeks and days to bring the participants to an acceptable level of performance and compliance to make the demonstration come off as planned.

From March 93, beginning with a kick-off coordination meeting during the DIS Workshop, meetings with prospective participants were held roughly monthly to develop detailed plans and rules for the conduct of the experiments and demonstrations. A running record of the actions and decisions arising out of these meetings was provided to all after each meeting (see Appendix A for the final synopsis).

2.2 GOALS

The goals for IDEMO93 included demonstrating that version 2.0.3 of the PDU Draft Standard was ready for acceptance. This was planned to be accomplished by using several of the new PDUs covering radio, emissions and simulation management. An increase in the number of participants and variety of simulator types, to include live, virtual and constructive, was desired. One goal not ultimately satisfied was the inclusion of a constructive simulation in the network. No owners of constructive models were willing to participate, this year. Another goal was that compliance testing be completed before the participants arrived at the event, to permit more time for rehearsal and experiments. The ability to conduct planned and controlled experiments to look at network loading, loading effects and other issues was a high priority.

2.3 INNOVATIONS FOR THE '93 EXPERIMENT

For IDEMO93, early planning called for several innovations in the conduct of the demonstrations and preparation for the networking to better support the event. Beginning with the fact that planning began much earlier for this years' effort than that of 1992 and that the level of interest in simulation technology was even higher, expectations were that more organizations would participate. In fact, the number of participants more than doubled. In anticipation, plans were made to bring in the services of a professional firm to establish and maintain the Local Area Network (LAN), with a stipulation that they provide a LAN monitoring capability such that if participants were observed corrupting the network and threatening the presence of others on the net, the LAN control center could readily disconnect the offender pending correction of the problem.

As to the demonstration itself, it was planned as a serial sequence of action with presentations spanning three days of the conference. Early planning focused on the use of a simulated newscast as the manner of presenting the participants' capabilities in an entertaining manner. This approach required a capability to present the simulated events coming off the DIS network simultaneously with the picture and voice of a live newscaster. Separate screens and projection equipment, along with a mock studio and additional video equipment were required to allow this presentation format. The level of effort that went into this part of the demonstration did detract somewhat from the ability to conduct rehearsals of the DIS network participants.

Foreign participants, including three British Labs, the Scottish company Marconi, and the French firm Sogitec, participated this year. The Defense Systems Internet (DSI) was successfully used to bring the British players live into the Marriott LAN, although just barely. The challenges of time differences and distance resulted in the British not being able to successfully complete testing until late on Friday of rehearsal week.

3. TEST PROCEDURE DEVELOPMENT

As the initial meetings to plan IDEMO93 were held, the "Test Procedures for Compliance Testing of the DIS PDU Standard IEEE 1278" were updated with procedures for the Logistics PDUs (version 5). The Test Procedures were further enhanced by adding adverse, erroneous, and capabilities tests. As the DIS PDU Draft Standard version 2.0.3 came out, the Test Procedures were modified to include PDU tests for Radio PDUs (Transmit, Signal, and Receiver) and the Emission PDUs (Emission and Laser, version 6) [IST93A]. Because the Testbed Tools (software) lacked the capability to perform adverse and erroneous tests, a reduced scope version of the Test Procedures was produced (version 6 reduced scope), dated July 25th, and distributed to all IDEMO93 participants [IST93B]. This version omitted all adverse, erroneous, and Logistics PDU tests (based on the decision to not use Logistics for the demonstration). The decision to omit adverse and erroneous testing was made because at that time the Testbed had no means to produce adverse or erroneous data and could not implement a tool to do so by the time the testing was to begin. (See Technical Report IST-TR-94-3, "Test Documents For DIS Interoperability", for the latest version of the Test Procedures. [IST-TR-94-03])

3.1 REVISION TO DIS STANDARD

The desire to reflect the most current version of the draft standard imposed a burden on the development of the test tools and procedures. The problem began with the fact that important parts of version 2.0.3 were not backward compatible with Standard 1278. Also, parts of the new version were not published until June. These then had to be incorporated into the test software and revised procedures.

3.2 CHANGES TO INCORPORATE NEW PDUs

Since IDEMO92, numerous revisions have taken place in the structure of PDUs. IST's DIS TESTBED Project was handicapped in development of the complete test tool set by the need to reflect the ongoing changes [IST-TR-93-30]. As discussed in detail later, the TESTBED had to plan to add tests for radio, emissions, simulation management and any other postulated new capabilities. As the planning process evolved, a subset of DIS 2.0.3 was implemented for IDEMO93. The players chose to implement only the Entity State, Fire, Detonation, Collision, Transmitter, Signal, and Emission PDUs. Some participants also chose to implement a limited set of Simulation Management PDUs with the understanding that they were to be experimental, not required, this year.

3.3 SIMPLIFICATIONS, ASSUMPTIONS, AD-HOC MODIFICATIONS

Several simplifications were made in the usage of PDUs. Only Dead Reckoning algorithms 1 and 2 were actually used. Algorithms 3 and 4 were planned to be used, but misinterpretation of the DIS standard caused different implementations of algorithms 3 and 4. The different implementations were not interoperable. The IDEMO players also decided on the use of bit 23 in the appearance field to designate entity deactivation. By agreement, entities were restricted to at most 2 articulated parts.

Only a limited set of entity types was permitted for the demo. IST provided a list of enumerations for "legal" entities. Creating the enumeration list entailed defining enumerations for new entities and munition types which were not in the DIS Standard. The final enumeration list distributed to participants is provided in Table 3 (Appendix 1). Complementing the enumeration list was a "hit-kill" matrix. The hit-kill matrix indicated which munitions could kill which entities. Damage was considered to be absolute--a hit implied either a kill or no-kill, with no partial damage (See Table 3 for the matrix used).

To keep the rules of engagement simple and visual depiction of entities simple, entities were to be classified only according to their entity type field. Force alignment was determined by using the force_id field. "Guises" were not implemented.

To minimize the number of missile visual models that had to be created and distributed for this event, a decision was made to use only two, TOW and Patriot, each in three sizes: small, medium and large. Since all missiles are similar and move fast, this was not seen to be a problem.

3.4 EVOLUTION OF TEST CAPABILITIES

Due to test tools not being fully developed to incorporate version 2.0.3 at the beginning of the demonstration planning effort, the TESTBED project was in the undesirable position of being unable to test all participants against all desired criteria early in the test period. As a result, some tests were deferred until the participants came together in Orlando.

Frequent updates to the TESTBED files on the bulletin board and on disks furnished to foreign participants for at home testing created confusion. IST was unable to effect the desired degree of quality control on the releases, due to the press of time. Some re-releases were required just to correct relatively minor errors, and in turn added to the confusion as to the status of the configuration.

One result of the group's willingness to approve changes in the scenario, kinds of players, etc., was that IST's test procedures and testing capabilities evolved during the summer. This resulted in more complete tests later in the process. Companies which tested earlier were not required at that time to take all of the tests due to incomplete tools. Later tests included new features and were, therefore, more complete. Companies which tested earlier were not required to return for the additional tests, but were required to complete the tests during Rehearsal week.

3.4.1 OVERALL SCOPE OF TESTING

To be thorough, each system under test should, ideally, be tested under three conditions: Ideal, Adverse, and Erroneous. Ideal tests verify that the system under test can correctly generate and interpret the DIS PDU standard. Adverse tests involve subjecting the system to conditions such as network failures, and data loss. Erroneous tests involve subjecting the system to data which is incorrect according to the DIS PDU standard.

During compliance testing of all the systems for the I/ITSEC 1993 interoperability demonstration, only ideal tests were conducted. This proved insufficient when the time came for all participants to interoperate. Many of the systems malfunctioned upon receiving adverse and/or erroneous data from others and a large portion of the time that was to have been used for rehearsal was spent instead, in overcoming that problem.

There is now a clear need to actively implement the adverse and erroneous test conditions and to subject systems to these prior to future interoperability demonstrations.

3.4.2 POINT-TO-POINT TESTS

Point-to-point tests were intended for systems which were going to use non-DIS traffic on the network. The reception test was never performed on participants, although technically they were supposed to pass this test (as a part of the network level test). The test for transmission of unicast traffic was performed on those systems that planned to use it. However, at the time of IDEMO93, many systems were issuing unicast traffic which they had not done when they had previously been tested.

The point-to-point tests conducted this year did not include the Address Resolution Protocol (ARP) either, as a result of adopting the reduced scope test plan. IST's software tools UTST and ATST were updated but were never used in the course of testing.

3.4.3 APPLICATION LEVEL PDU TESTS

The purpose of the Application Level PDU tests was to determine whether a system was capable of constructing and interpreting the various PDUs correctly. There were a number of PDUs which were not fully tested for prior to initial testing.

The IST/CGF, a primary testing tool, was not equipped to generate any of the radio PDUs, namely the Transmitter, Signal and the Receiver PDUs. It was only after testing the Naval Air Warfare Center/Training Systems Division (NAWC/TSD) that a sample of radio PDUs was obtained and used to perform reception tests on other systems. Unfortunately, since NAWC/TSD was the first organization to be tested, the radio reception test was never formally performed on them.

Similarly, the IST/CGF was incapable of generating any of the Simulation Management PDUs (such as Create, Start, Stop, etc.). One participating organization volunteered to log a batch of such PDUs for IST to use for reception testing of other systems. IST did not have the manpower or knowledge of format to write a conversion tool. A second batch of simulation management PDUs was never obtained. As a result, this reception test was never performed during the scheduled test phase and it was decided to subject participants to these PDUs during the practice and demonstration weeks by having systems that implemented Simulation Management send traffic on the network.

Transmission of simulation management PDUs was not verified for correctness during compliance testing based on the decision by the participants to allow them only as "experimental" traffic, not to be used during demonstrations. In retrospect, it would have been desirable to test systems against these PDUs in advance as there were occasions when Simulation Management PDUs intended to control a system in one booth affected unintended destinations.

Emissions PDUs were also not consistently tested for all systems. Logged PDUs were obtained from organizations which intended to use them and desired to be tested for emission PDUs, but there was a significant delay in analyzing the recorded data. Because the Emissions

PDUs were being implemented by IST later than most other PDU structures used, it took additional time to develop the test procedures for them. Much of the delay resulted from difficulty in obtaining a complete list of enumerations for emissions data types.

Midway through testing, Emissions capability was added to the IST/CGF. From then on, Emissions reception tests could be performed on the SUTs. However, the systems which had been tested prior to that moment were not subjected to that testing prior to arrival at the demonstration. They were required to complete testing during the rehearsal week.

3.4.4 TERRAIN DATABASE RELATED TESTS

A new version of the Ft. Hunter-Liggett (FHL) terrain database was prepared by Project 2851 for this years demonstration. Because it was not completed and released until August, much of the terrain related testing and test preparation had to be based on the database used for IDEMO92. That database had already been used and most organizations had it or could acquire it. While different from the updated version, it served the immediate needs of the compliance tests.

IST also performed terrain skin Z-correlation tests. These were run using the final version of the Ft. Hunter Liggett database. Details of the procedure are contained in a separate report [IST-TR-94-07], but the process consisted of participants being given 2000 x,y coordinates and responding with their z values. Their values were then compared to the values provided by the database developer (Project 2851) and assessed statistically. While everyone was asked to participate, only nine companies submitted data for this test.

The good news from this part of the compliance test process is that the degree of correlation had improved markedly, compared to a correlation sample submitted to IST by many of the same firms only a few months earlier. For example, the largest "Mean Delta Z" submitted for the final evaluation was just under 0.5 meter, and the next worse was less than 0.023 meter. These represent a two orders of magnitude improvement over the evaluation data submitted by participants for the first series of correlation studies.

3.4.5 DEAD RECKONING TESTS

Early in the planning process, on 27 April, 1993 participants voted to use four dead reckoning algorithms (1,2,3&8) for IDEMO93. This decision required testing capabilities to be added for all four algorithms. Just three months before the demonstration, at the meeting on August 24, the participants decided to change to 1,2,3&4. The TESTBED did not complete the implementation of the algorithms until a few days prior to the scenario rehearsal week. The testing and validation of the software was not completed, which led to none of the organizations being validated on any dead reckoning algorithms other than number 2 (linear velocity).

3.4.6 RECEPTION TESTS

The purpose of the reception tests was to ensure that the SUTs could correctly interpret all DIS PDUs. One test went through numerous modifications because it depended on the list of entity enumerations which kept changing late into the demo planning phase. The primary reason for this list being continually updated was the fact that organizations did not adhere to the deadlines for submitting to IST the kinds of vehicles and munitions that they planned on using during the demonstration. In trying to support the participation of all, and accepting late changes, there was an insufficient update rate between the scenario developer and the entity-list coordinator, leading to two different lists of entities. It was this reception test which was applied in the most inconsistent fashion to all the participants, but this did not prove to be catastrophic during the demonstration week.

4. COMPLIANCE TESTING ACCESS

In order to make the TESTBED as usable as possible, three methods of access were offered to its users. These were:

a. Telephonic connection, using two 800 numbers furnished by IST.

b. Coming into the IST laboratory with the equipment to be tested.

c. Exchange of logged files of network traffic which IST would then evaluate.

Also, as an exception, the TESTBED was moved to another (local) site for a test on one occasion, as it afforded a unique opportunity to perform an early checkout of IST's test capability. Each of the other approaches will be discussed as to its unique features.

4.1. USE OF THE 800 NUMBERS

The DIS TESTBED includes two Toll-Free (1-800) numbers for testing purposes. These numbers are combined with four regular phone numbers to support dial-up testing of up to a maximum of three simulators simultaneously. The regular phones are used in conjunction with the (1-800) numbers for voice coordination during testing. Testing can also be performed using two regular phone numbers to support a third system when applicable. The two toll-free numbers are programmed into the BReezes and Netblazers so that when a remote site generates DIS packets, the BReeze or Netblazer at that remote site will automatically dial the DIS TESTBED, make a connection and begin packet exchange. This method of testing is capable of transferring data at 50 k/bits per second (with data compression enabled) and is only suitable for low bandwidth simulations. Simulators putting out PDUs at a rate greater than approximately 25 PDUs per second may present difficulty in testing due to a loss of packets when the maximum throughput is reached. The only requirement for the System Under Test to participate in (1-800) number testing is an analog phone line and an isolated network at the remote site.

4.1.1. DESCRIPTIONS OF THE ACCESS EQUIPMENT

Many different pieces of vendor equipment were examined and several were tried, in the effort to arrive at a sufficiently capable interface unit. The requirement that the device support reasonably high throughput and broadcast PDU traffic, while being rugged and inexpensive was a challenge. Finalists in the competition are described below.

4.1.1.1 ORIGINAL NETBLAZER DESIGN

The original Netblazer design was composed of two Telebit Netblazers and two Telebit T3000 modems with one of each at each site. The original design was conceived in June 1993, before the Test Procedures were fully developed. Because the Netblazer acts as a router and is limited to transferring point-to-point traffic, the test procedures required configuring the SUT and IST's PC-based CGF to output only point-to-point traffic. This proved to be extremely difficult for most participants and violated some basic principles of DIS [Chatterjee93]. Only one organization tried to test using the original Netblazer design and they were unsuccessful.

4.1.1.2 THE HUMPHREY BRIDGE

A partial solution to the problems of the original Netblazer design was developed at IST. This is the Humphrey bridge, which is PC-based software that converts local broadcast Ethernet packets to Point-to-Point Ethernet packets and converts local Point-to-Point Ethernet packets to broadcast Ethernet packets. The software was written to run on a PC, but the choice of platform was for convenience only. A copy of the Humphrey bridge is needed on both sides of the dial-up link. In the case of a particular packet, the Humphrey bridge at the source LAN reformulates and retransmits every DIS broadcast packet generated locally as a point-to-point packet, which the Netblazer ST will transmit onto the phone line. The Humphrey bridge software on the destination LAN reformulates and retransmits the point-to-point packet it receives on the phone line as a broadcast DIS packet on its LAN. Because it retransmits every packet, it doubles the Ethernet traffic. The Humphrey Bridge runs on any PC (386 or 486) with a 3COM Etherlink II or III network interface card. The configuration of the Netblazer and Humphrey bridge proved to be cumbersome to work with, however. Two organizations tested successfully using this configuration.

4.1.1.3 BREEZE 1000™ CONNECTION

The BReeze 1000™ manufactured by Networks Northwest proved to be the easiest and most effective design used. This device is a dial-up bridge-router with a built in modem. It is capable of transferring data at 50 k/bit per second when its data compression is enabled. For compliance testing, a BReeze 1000™ was configured in bridging mode (with the forward multicast packets switch enabled) so that it would pass all network traffic. When the BReeze 1000s™ were used, unmodified DIS systems could be linked. The BReeze 1000™ design solved all testing problems except the throughput limitations of the phone lines. Simulators emitting packets at rates greater then 25 PDUs per second would overload the net. This did not prevent compliance testing a system, but could make the job more difficult. The BReeze 1000™ units were configured at IST and "FedExed" to the remote sites. When the unit arrived at a site, the recipient only needed to plug in the telephone line and network connection. The BReeze 1000™ units proved to be very reliable. Once a mechanical problem had been fixed by the manufacturer no other hardware failures were encountered during the entire I/ITSEC testing period.

4.1.2. NETWORK EQUIPMENT SUPPORT

Network test equipment was configured and maintained by all TESTBED personnel. Support ranged from equipment logistics to detailed configuration of networking equipment. IST purchased two shipping containers that were used to transfer all the necessary equipment for a remote site. Companies arranged with IST's Test Coordinator to schedule a test time. Two days prior to a scheduled test date, the test site was contacted and overnight shipping arrangements were made. The test equipment was shipped either directly from IST or from company to company to allow for the tight test schedule. Once the test equipment arrived on-site detailed instructions in the shipping container guided the organizations through BReeze 1000™ setup and network configuration (see Appendix B, BReeze 1000™ Testing Procedures Handbook). Two telephone lines were used to perform compliance testing. Voice coordination was established on one line and data transfer was established on a (1-800) line. SUT networking setup and compliance problems were debugged over the voice line. One problem encountered in shipping the test equipment from one company directly to the next company was that small parts (ethernet T-connectors, terminators, instruction manuals and power cords) disappeared from the test kit. Some companies were not thorough when repacking the test equipment and omitted the above mentioned parts.

4.2 DATA LOGGED TESTING

IST strove for flexibility in compliance testing by providing multiple ways for an organization to perform testing. The most flexible of these mechanisms was the exchange of logged network traffic. Data recording was accomplished at the organization's site, at their convenience, and required that the organizations run the test scenarios themselves and send the logged data from the tests to IST for analysis. To facilitate logged testing, IST created the "Logged Testing Instruction Booklet" included in [IST-TR-94-03]. This booklet describes what equipment to use to perform the tests, how to perform each of the tests, and how to save the results of the tests. It also states how to send the data to IST for evaluation. IST issued these booklets to all participants who requested them. An organization choosing the logged testing method had to first have IST's Computer Generated Forces software running on a PC and IST's Data Logger running on a second PC, similar to the setup in the IST TESTBED lab. The Data Logger software includes Logging and Playback tools as well as script and binary files used for logged testing. The script files can be used to run the CGF to produce entities which will send out specific sets of PDUs. The binary files contain the network traffic resulting from the CGF running the script files and can be presented to the system under test rather than running the CGF. The script and binary files are named to reflect the test they represent. As an organization runs the tests, their SUT must transmit data (if it is capable) and receive data. If the SUT is designed to interoperate with other DIS systems, then the organization must make their system interact with entities created by the CGF. All of this activity must be recorded with the Data Logger.

Six organizations chose to use this method of testing. This is the most flexible of the three. Disadvantages are that feedback from the tests was not immediate, IST had no control over the integrity of the test data, and organizations could run the test incorrectly, requiring tests to be rerun when errors were discovered. Another disadvantage is that the organizations had to spend considerable time getting the CGF software and Data Logger to run and in becoming familiar with these tools. If an organization didn't have PCs or had different network cards, it had to purchase the correct hardware in order to test this way.

4.3 TESTING AT IST

At the April 27 coordination meeting, agreement was reached by all participants that every system to be on the demo net would go through DIS compliance testing. The testing was originally scheduled to start on September 27, 1993, and end November 12, 1993. Testing actually started on September 29th and was extended to November 18th. Two weeks prior to rehearsal week IST contacted all organizations that had not tested to encourage them to test during the remaining time. IST also tested after normal hours and on weekends, but could not force organizations to test by the cutoff date. The number of organizations that tested prior to Rehearsal week is shown below:

TABLE 1
TEST LOCATIONS PRIOR TO REHEARSAL

Home Station Test	1
Tested at IST	16
Long Distance Test	18
Used Logged Files	6

IST tested more organizations with fewer people for IDEMO93 than for the previous year. This was accomplished through greater insistence on early test scheduling and better test tools. Although largely a success, problems were abundant. The following types of problems were encountered.

1. Testing was not consistent

    a. Enumerations changed weekly.
    b. Emissions were added late.
    c. No Simulation Management testing was available until Rehearsal week.
    d. The Terrain Database used for most testing was last year's version.

2. No higher order dead reckoning algorithms were implemented in the IST CGF. Therefore, systems were not tested in this area.

3. IST manpower and equipment shortages impacted testing and support and did not allow IST to get everything done that was planned. Testing was more labor intensive than had been envisioned.

4. The full range of possibilities was not tested (erroneous data, adverse data, high traffic loads, etc.).

5. Problems with test tools:

   a. CGF, logger and Scanner were constantly being upgraded.
   b. PC's ethernet card has severe traffic limitations and could drop packets in some situations.
   c. The telephone link was limited to about 50 Kbits/second.

6. Long Haul Problems:

   a. Bad phone lines put undefined or incomplete PDUs on network, or sometimes couldn't connect.
   b. Internal networks of organizations and phone switches at other sites caused noisy or broken connections.
   c. Confusion between US Mail zip codes and Fedex zip codes caused BReezes to be returned or delayed delivery creating scheduling problems.
   d. Equipment from BReeze boxes (ethernet cable, T-connectors, terminators) was "lost" at some sites so subsequent organizations got incomplete shipments.

IST observed problems that occurred frequently, and with numerous organizations. The following is a list of the most common problems:

1. Misinterpretation of the DIS standard or use of an old version of the DIS standard.
2. Using the wrong IP Network address class.
3. Using the wrong UDP port number.
4. Confusion about the implementation of Bit 23 of the Appearance field
5. Values out of range.
6. Incorrect coordinate conversions.
7. Poor terrain database correlation.
8. Incorrect enumerations.

Most of these problems were a result of system implementors not getting the information on decisions made at the planning meetings. Anecdotal information suggests that the majority of problems resided within the organizations, where decisions from the coordination meetings were not disseminated to technical staff.

4.4 TESTING DURING REHEARSAL WEEK

Eight organizations did not test until Rehearsal week. Of the organizations that tested prior to that time, 19 had to be retested. Retesting was a combined result of organizations not having finished implementations and IST not having all of its test capabilities available during the scheduled testing period (e.g. emissions). Foreign organizations posed some different problems in testing by not being able to use the 1-800 numbers and by not being able to test in-house without great expense. This left testing via logged files, but this used the Ft. Knox terrain database so correlation with the FHL database was an open issue. The British Government's facilities participated through the DSI and because of delays in getting their network links operational, couldn't get logged files to IST prior to Rehearsal week. As a consequence, all foreign participants had to do some form of testing during that week.

To accommodate that testing at I/ITSEC, IST had three mobile test systems available to roll to the SUTs. Each system consisted of two PCs connected with thin ethernet and an extension of ethernet cable to connect to the SUT. PCs, monitors and test materials were placed on wheeled carts. The carts were painted black and some participants nicknamed them the "carts of doom". IST kept all three test systems manned during rehearsal week, except at night, between 1 am and 6 am, when usually only one system was manned. Testing was suspended between 1200 and 1800 on Thanksgiving Day.

Testing during Rehearsal week was scheduled on a priority basis. Organizations that had tested prior to Rehearsal week and had only one or two tests left were given highest priority. Organizations that had tested previously and had more tests left were given next lower priority, and organizations that had not tested at all were given lowest priority. The only exception to this was given to those organizations using the DSI to come into the show. They had priority during DSI availability times. As organizations set up their equipment and were ready to test, they informed IST and were put on a list to be tested. Testing was done in two hour increments and if testing for a system was not completed in that period of time, the organization's name would be put back on the bottom of the list. When it came time to test a system, if the organization was not ready or no one from the organization was available, the tester would go to the next organization on the list. For the most part, the problems found while testing during Rehearsal week were the same as those found earlier. What did occur, however, was that as organizations started interacting with each other, problems arose that were not previously tested for. The following are some of those problems:

1. IST did not test systems during initialization (power-up) phase and there were several systems that put out packets with bad values during this process.

2. At the demo, non-DIS traffic caused problems.

3. Some systems put out a negative zero, which is a valid floating point number but was observed to hang some other systems.

4. Several organizations put out PDUs with values out of range.

Once a problem was identified, the offending organization was notified and isolated from the network until the problem was resolved. As more organizations passed compliance testing, IST converted test systems into network monitors to observe the rehearsal for the demonstration. IST maintained one system in the test configuration until the first day of the conference. At that time there was still one organization that had not completed compliance testing.

5. INCORPORATING NEW ENTITIES, CAPABILITIES AND FEATURES

One of the more insidious problems encountered in preparing for this event was the lack of stability in the material the TESTBED and the industry participants had to deal with. Recognizing that DIS is an evolving technology, a degree of instability may be unavoidable but it certainly needs to be recognized and accounted for in planning similar events. Incorporating new elements and capabilities is technically possible, given adequate time and funding to support the changes for all who are affected. It was observed that the impact of change is distributed, just like the simulation. It affects the user and tester alike. In the future, better control over the change process and more disciplined configuration management could help reduce the last minute rush for testing. During the summer and fall of 93, IST staff received numerous phone calls requesting assistance or clarification and attempted to respond to all during the preparation process. These are categorized in [IST-TR-94-01].

One problem recognized early was the need to define who and what was going to participate. Both DMSO and the I/ITSEC Steering Committee publicized the demonstration early. The DMSO in particular attempted to stress to DoD contractors and government agencies the importance of supporting the event. Even so, many firms committed to participate only a few weeks before the demo while others who had participated in the planning sessions throughout dropped out at the last minute. While rules governing an event can keep late-comers out, there is no way to force firms to participate, so long as their participation is voluntary and paid for out of their own resources.

Some participation problems arose out of conflicting demands for resources. For example, the Association of the United States Army (AUSA) conducted a DIS demonstration in Washington, D.C. in late October. Several prospective participants in IDEMO93 remarked that the resources required for the AUSA were all they could afford to expend. Other problems were linked to the lack of coordination between the technical and marketing organizations in some firms. In most cases, the marketing side must make the financial commitment to support coming to the conference and participating in the demo. In several instances this commitment was not made until very late, so the availability of specific entities and capabilities remained in doubt. The floor layout of the LAN network stayed fluid as a result so that IST could not insist on a detailed layout of the physical network, in advance.

5.1 CONFIGURATION MANAGEMENT PROBLEMS

The environment surrounding an evolving technology, such as DIS, makes rigid configuration management processes difficult to impose. As a result, changes continued to creep in after agreed cut-off dates. At least two factors encouraged the incorporation of last minute changes for subsequent demonstrations. On the one hand the companies supporting and sponsoring the event wanted and expected the privilege of bringing in their latest creation as a part of their marketing strategy. On the other, the bulk of the labor involved in the standards development process was volunteer, so many are squeezing in standards work between other work assignments. It is therefore not easy to support hard and fast rules on when their work must be done.

The first factor created the greatest problem this year. Whether because of last minute decisions or simply communication problems, there were changes to the entity and enumeration lists almost weekly and each required a new release of the testbed software. This placed a burden on TESTBED staff and participants alike. Changes to the DIS standard were less a problem, although the definition of emitter PDU usage was fixed relatively late.

The impact of late changes was the requirement it imposed for last minute check testing at the site of the rehearsal and the attendant risk that firms that tested early might be impacted by the change. Because future demonstrations of this nature will likely depend upon volunteers and decisions by popular vote, the organizers and participants need to be apprised of the ripple-down effects of change as a prerequisite of voting on cutoff dates for specified changes or additions. They particularly need to know the likely delay between cutoff and the incorporation of the change in the test process.

5.2 AMBIGUOUS TERMINOLOGY

In developing the enumeration table and the hit-kill matrix it was noted that some definitions are loose. This began to manifest itself immediately in drafting the initial enumeration table for IDEMO93. Upon examining the Capabilities Statements which had been submitted by prospective participants, we found that many developers either did not understand, or did not take seriously, the requirement to identify the entity(s) which their application could or would simulate. Responses to this question often simply contained the developer's internal name for the simulation itself (e.g. Acme High-tech Simulator) without identifying any entities. At the other end of the spectrum, one respondent stated "anything and everything." Responses like these required follow-up phone calls to dozens of organizations in order to just start the IDEMO93 enumeration table.

Another muddy area was the definition of the Country field in the Entity Type record of the Entity State PDU. Does this field represent an entity's country of design, manufacture, or ownership? Unfortunately, the PDU Standard used for IDEMO93 (version 2.0.3), its supplementary volume of enumeration and bit-encoded values, and various participants were not all consistent on this question. This issue was not resolved for IDEMO93 until the Sep 93 DIS

Workshop, at an abbreviated Demo Planning meeting held during an evening session, resulting, of course, in another iteration of the enumeration table. IST plans to tackle this issue with the ITMC Working Group at the March 94 Workshop.

There was also some confusion about reconciling the large variety of entities which participants wanted to simulate with the small number of available visual models. Early versions of the enumeration table were restricted to only those entities for which a visual model was available. Models used this year are listed in Table 2. This position was reversed at the September meeting, where it was agreed to allow simulations to "be" virtually any platform and fire virtually any munition (consistent with the scenario); responsibility of choosing a visual model for these entities would fall on the simulation receiving the PDU, not the one transmitting it. This agreement resulted in an immediate proliferation of entity types on the IDEMO93 enumeration list shown in Table 2. This list was also used to provide a numerical identity of the model to be used to portray each entity, where appropriate.

TABLE 2
VISUAL MODELS AVAILABLE FOR USE IN IDEMO93 (Version 3)

AIR
1. V-22 (S)
2. AH-1W (S)
3. OH-58 (S) SIF
4. KC-130 (M)
5. AH-64 (SIF)
6 F-15E (S)
7. F/A-18 (SIF)
8. F-16 (SIF)
9. UH-60 (SIF)
10. RAH-66 (Commanche)
11. PATRIOT Launcher (SIF)
12. UAV (SIF)
13. HIND (SIF)
14. SA-(2,5,6,8,9) (Patriot Missile - SIF)(SA-6 Site)
15. MiG-23 (S)
16. MIG-29 (S)

SURFACE
17. LHA (SIF)
18. Aegis Cruiser (SIF)
19. Submarine Periscope (M)
20. CV (M)
21. FFG-7(M)

LAND VEHICLES
22. M-2 (SIF)
23. LOSAT (S)

24. Bus (M)
25. Army Truck (S)
26. Black Civilian Car (M)
27. T-72 (SIF)
28. BMP (SIF)
29. DI (SIF)
30. M-1 (SIF)
31. NLOS/Avenger (S)
32. Virtual Prototype Tank (M)

UK MODELS

33. Warrior Combat Vehicle (S)
34. Challenger Tank (M)

NEW MODELS UNDER DISCUSSION

35. X-31 (I)
36. SCUD with TEL (S)
37. ThAAD Launcher (M) (I)
38. TOC (3-D Structure)
39. ZSU-30 (SIF)
40. Explosion (SIF)
41. Missile Fragments
42. Bi-Plane
43. TOW

(S)= SIMNET »2851 SIF; (M)=Multigen » 2851 SIF

Compared to these tribulations, constructing the Entity Interaction Matrix was somewhat simpler, if only because it was absolutely arbitrary. Every change in the enumeration table, however, did require a corresponding update to the rows and columns of the Entity Interaction Matrix, Table 4 (Appendix 2).

5.3 ENUMERATION TABLES FOR NEW ENTITIES

There were entities brought into the network this year that had not been previously defined. As DIS is used for concept exploration more frequently in the future, this will occur again. There is a need for a quick response capability to define these new entities. The enumerations document serves as the database from which to retrieve a string of seven enumerations which uniquely defines an entity in the DIS world. A new entity is defined by locating the nearest subclass in which it belongs and by assigning the next integral number in that subclass. Thorough knowledge is needed to correctly insert a new entity in its correct location, and this expertise is derived from either the organization requesting to use that entity or from an expert in the subject. Distribution of this database was the main bottleneck in consistent testing of all organizations. Organizations introduced more entities than originally planned, thereby modifying the list of entities that all participants needed to recognize. The maintenance of this entity database should be centralized and updates should be distributed consistently to all interested parties.

6. COORDINATION OF PARTICIPANTS

Prior to the event the primary mechanism for coordination was a series of monthly meetings where issues could be discussed and decisions made. At these meetings issues pertaining to all aspects of the demo were open to discussion. Issues ranging from the schedule for testing and the rehearsal to which PDUs would be used were subjects of the meetings. Issues were voted upon, with each participant organization afforded one vote. Minutes, along with an updated copy of the record of actions and decisions was sent out by e-mail (preferred), mail or fax soon after the meeting. Generally the presentations included several important transparencies and in these cases the minutes, actions and decisions and presentations were sent by mail to named lead personnel at each participating organization.

6.1 EVOLUTION OF PARTICIPANTS

Early meetings of the coordinating group saw upwards of 60 companies represented. However, several who ultimately participated in the demo did not show up at the early coordination meetings. In spite of requests for early commitment, they came slowly. Coordination between the technical staff, with whom IST worked, and the marketing elements of the participant firms was often poor so that in many cases lack of booth space commitment limited IST's ability to plan the network configuration in advance. The organizations who actually participated in IDEMO93 are listed in Table 5. In addition to those who participated, there were many organizations that attended one or more coordination meetings. These organizations are listed in Table 6.

6.2 DEVELOPING DEMONSTRATION SCENARIOS

The process of scenario development was long, convoluted (involving numerous iterations with the participants) and largely unsuccessful (due to lack of integration between the demonstrators and those responsible for the "artistic" aspects of the presentation).

The process of scenario development used during IDEMO93 was established by trial and error during IDEMO92. Most of the participants in IDEMO92 wanted maximum information as soon as possible on what they would do in the scenario in order to design their simulator to fit the script. This they saw as more important than designing their simulator to match the capabilities of the modeled system.

Participants were screened for capabilities and asked to input suggested scenarios. The responses ranged from detailed, well-thought-out scenarios to the simple "You tell me what to do and I'll do it. From these suggested scenarios and capabilities statements the initial scenario outlines were developed.

TABLE 5
Organization Participants in IDEMO93

Armstrong Lab	Lockheed
Army Personnel Research Establishment	Loral
ARPA SAIC Warbreaker	Northrup
Boeing	PRC Corporation
Booz, Allen, & Hamilton	Raytheon
CAE Link	Reflectone
Coleman Research	Rockwell
Concurrent Computers	SAIC
Defense Operational Analysis Center	Silicon Graphics
Defense Research Agency	Sogitech
Digital Equipment Corporation	SSTi
Encore Computers	Technology Systems Inc.
ESL	Texas Instruments
Evans and Sutherland	TRW
FAAC	US Army STRICOM
General Research Corporation	US Army TARDEC
Hughes Training	Unisys
IBM	USAF Aeronautical Systems Center
IDA	VEDA Inc.
Kaman Sciences	

TABLE 6
Organizations Represented at One or More Meetings, but Not in IDEMO93

American Systems Corporation	Koan Corporation
Applied Data Technology	Kollsman
Barco Chromatics	Litton Applied Technology
BDM Federal	LNK Corporation
Calspan	Logicon
CTA	Magnavox Dace
Decision Science Applications	MRJ, Inc.
Defense Mapping Agency	NRaD
Defense Nuclear Agency	Planning System Inc.
Electronic Warfare Associates	RDA
Firearms Training Systems	Softech, Inc.
General Dynamics	Sonalysts, Inc.
Greystone Technologies	SRI International
Grumman	Syscon
GTE	Teledyne Brown
Harris	US Army Space & Strategic Defense
Jade Simulations	US Army Topographic Eng. Center
Johns Hopkins	Westinghouse

IDEMO93 set out to create an environment to overcome any poor preparation and performance demonstrated in IDEMO92. The earliest scenario design meetings called for a broader range of players (48 companies and government agencies) using more visual models (43 visual models were finally produced) and more players (73 networked simulators, both send/receive and receive-only were on the network).

Scenarios were designed to demonstrate the "true" capabilities of the simulated entity. Tanks moved at realistic speeds, missiles flew real distances and validated numbers were used when available. The scenarios were designed to display the performance of the modeled entities and the capabilities of the hardware and software of the various simulators. If a real ship fired a Surface to Air missile, the simulated ship fired the same missile using the modeled range, elevation and performance criteria of the real Surface to Air missile. The limitations of the display Stealth to depict firing signatures severely limited the "action" available through the visual medium of the Stealth screen. The missiles were fired and hit and killed networked entities, but the Stealth simply could not display the effects.

Designing a scenario to the fixed limitations of the visual, entity oriented display was frustrating as it did not allow intelligent play between modeled entities. Surface ships do not close to visual ranges in this modern era of Ship-to-Ship missiles. Depicting a sea engagement at unrealistically close distances hides the true capabilities accurately modeled into the networked simulators participating in the demo. There are other means to introduce the viewing public to the scenario besides the visual screens created by a Stealth. An enlarged Planview display could have depicted the locations of all the networked players to include those like emissions players not capable of being visually modeled.

Scenario scripts were distributed in advance to all the players (See example, Appendix C). The non-availability of a fully capable and tested Stealth, as well as its employing a Terrain Database that had not been through correlation tests prior to the start of the demo, was a serious problem. Events did not always happen as scripted and entities did not always appear where intended. Because the action could not be seen on the presentation screen until the last moment, serious delays were experienced in finalizing the planning and rehearsing of specific demonstrations.

Scenario rehearsal started in earnest on Thanksgiving day with the participants who were available. The delay in starting was caused by constant interruptions due to crashing of the Stealth and networked simulators and erroneous traffic on the network. The lack of stability in the Stealth was the single most detrimental flaw in the scenario development and rehearsal. There were players who were never visualized once, for the public view, by the Stealth.

Beyond the frequent crashes, the new Stealth was very difficult to attach to a specific Entity. Because of the slow redraw rate, the ModSAF Planview Display had to be kept at minimum scale at all times, resulting in an overlapping of icons. Because of the overlap, the operator could not always attach to the desired entity. When the Stealth would not attach to an entity the audience didn't get to see the intended event. That doesn't mean a missile wasn't launched, it simply means the Stealth didn't show it. It was a matter of luck to capture a high speed model in the right location at the right time, thus it was almost impossible to follow a sequence of events as scripted.

From a historical reference, the Stealth was originally intended to provide a perspective on the network of players for an intelligent After Action Review (AAR) and to allow non-intrusive observation of participants during play. As a means of showing the activity on a DIS network, the Stealth visual and sound recreation worked well when the activity was limited to physical entities. However, when the exercise included the interplay of emissions, radio, radar and sigint activities--activities that could not be shown through visual models-- the use of a Stealth id does not answer the need.

6.3 INFORMATION FLOW

The hands-down preferred method for coordination, whenever a meeting is not required was the E-mail connection. It is so efficient compared to alternative communication methods that it should be required for all who wish to play. Even using E-mail, there were issues that might have been resolved before rehearsal that were not, due in part to failure to communicate.

A case in point was the difference in interpretation of the DIS Standard on dead reckoning algorithms. The allowed algorithms had been selected in two separate planning meetings and different sets were chosen at each. After the last decision two full months passed and then, during the demo rehearsal, the group decided to change DR algorithms again, in large part because they did not agree on the definition of how the previously agreed models were to be implemented.

Another problem was the situation in which companies would send different people from the participating unit to sequential meetings or send people from one unit who were expected to represent the interests of all the other company units. In many cases this inconsistent representation created problems, both for IST in coordinating and test planning and the companies themselves in keeping abreast of the planning status. Team-wide access to E-mail coverage of the planning process could have minimized problems.

7. CONDUCT OF THE EXERCISE

The actual process of integrating the hardware, software and people involved in a demonstration of this size required much more time and effort on site than originally envisioned. There were many factors that contributed to this finding, some of which might be avoided in the future, and others that probably come with the size and relative experience of the participants. Factors outside the control of the players include the extended time required to get nearly fifty participants moved in and functioning and the requirement to hold off on laying the LAN cables until the heavy equipment finished moving the participants into position.

Many of the complications were avoidable. Supplemental generators had to be secured to support the rehearsal after we started setup because numerous companies had failed to respond to the many requests that they provide JMK (the display coordinators) information on their space and power requirements. Also, extensive time was spent ferreting out the sources of unwanted and disallowed network traffic. This process was so difficult that IST ended up having to put companies on the primary net one-by-one and checking their output for problems. This consumed a six to eight hour period that ran until almost midnight Wednesday, after two previous days of effort had failed to eliminate the errant traffic.

As was observed by one participant, players could have made their systems more tolerant of errant network traffic. He cited, for example the ability to simply instruct a simulator to ignore/discard PDUs that contained out of tolerance or non-allowed values. He admitted that the time crunch of getting the essentials ready precluded his implementing the "armor plating" features he described. IST recognized that the capability to tolerate erroneous PDUs was a desirable capability for demo participants but, due to lack of needed tools and time, had agreed with the participants to employ a reduced scope of testing in planning for IDEMO93 that did not evaluate this capability.

7.1 SUPPORT INFRASTRUCTURE REQUIRED

To support an event such as this demo, certain essential resources must be provided. These obviously include a facility or facilities, communication linkages for players and their computers and a mechanism for showing the audience what is being demonstrated. The facility needs include those for performing the pre-demo systems integration and rehearsal, as well as the object demonstration.

Beyond the physical infrastructure, and considerably more critical to the successful conduct of a demonstration at I/ITSEC, is the need for an engine to drive participation. Supporting and playing in such an event costs the participants significant money, labor and time. The rock bottom investment might be as little as $25k for a firm in Orlando which has a sponsored DIS effort ongoing, but a small sample of major players questioned indicated that they had spent from several hundred thousand dollars to over a million to participate. To convince them to expend these resources, there must be a market demand or business opportunity for their capability. To date the prospects of DoD business has provided the requisite incentive. As defense budgets decrease, future demonstrations may need to target audiences outside DoD to a greater degree.

7.1.1 COMMUNICATION WITH PARTICIPANTS

At both IDEMO92 and 93, demonstrations of networked simulations have been dependent on voice communication for coordination of the participants. Both years, the primary link was the "walkie talkie". This year, fifty units were donated by Motorola to support the internal communication needs. With forty-two separate players and the IST staff required to provide support to them, there were barely enough. We had to issue appeals to the participants to return radios not absolutely required so that all companies could receive one. Thanks to the excellent reliability of the units (not one failed to perform) we could function. Thanks to the honesty of all involved, none were lost.

Radios were checked out by serial number, on a one-per-company basis to individuals. The remaining units were signed for by the support staff. The size of the Marriott facility where the demonstration was held imposed distance limit problems on the radio. During rehearsal this was not a problem as we were all in the same ballroom but when we dispersed for the formal conference the distance limit became obvious. Had this been known in advance, repeaters which are available could have solved the problem. This needs to be considered in future planning of events at that facility.

As it happened, during the planning process participants had agreed to use the Hotel's public address system to augment the radios. While this system also had limits due to volume settings, which varied by area at the whim of the hotel engineers, and background noise contention, it was a necessary and effective backup to the radio.

For communication with the long haul participants from locations throughout the rehearsal and demonstration areas cellular phones were employed. Since feedback on success of the demo could only be gained from viewing the demo Stealth, it was believed that this linkage would be essential. In retrospect, there were enough other phones and radios available that cellulars could have been eliminated, although a telephone at the IST site was essential to coordination. Shielding by the building structure and RF interference limited the usefulness at times.

A future possibility for communication between participants may be the use of the DIS radio PDU. If used, it would provide linkage to all players on site and to those off site who have sufficient bandwidth in their communication link. Depending upon network loading and capabilities, filtering schemes might be required off site. A version of a radio, developed to support the ARPA "Warbreaker" program was used on the net in an experiment this year. At present it exists in very limited quantities.

The option of using the DIS radio for primary communication is complicated by the need to gain the agreement by all participants that they will implement that part of the Standard. Presently, players elect to implement only select PDUs as reflected in their product line and interests of their customer base.

7.1.2 NETWORK ISSUES

One of the major lessons learned at IDEMO92 in San Antonio was the criticality, and potential fragility of the network that ties the participants together. It was also learned that it was the ultimate control point that IST could use to take errant traffic out of the exercise, if required. Attention was therefore placed on trying to insure that the network was both robust and readily manageable, in the event any problem sources needed to be taken off the display network.

7.1.2.1 LOCAL AREA NETWORK

The network design was based on the lessons learned from IDEMO92. This year, the network was designed to provide greater flexibility. This included a provision for operating up to three independent Ethernet networks through an architecture based upon switchable hubs and a star topology. This configuration was chosen so that groups could do separate demonstrations, experiments or practice their scenarios. The ability to quickly link the hubs allowed all to be grouped together on one main network almost instantaneously. Through most of IDEMO93 the three networks were used for the following functions:

- Network 1 - Main Show Network - Used for all scenarios being viewed on the Stealth.
- Network 2 - Practice Network - Used by different groups to rehearse and experiment (i.e. radio, emissions, etc.)
- Network 3 - Administrative Network - Used for file transfer, E-mail and other administrative functions.

The design was accomplished by using three Digital 900 LAN Hubs in each ballroom. Each LAN Hub supported its own Ethernet network. The hubs were then bridged together to form the main show net or unbridged to form the multiple Ethernet networks. The ballrooms were connected with three pairs of fiber optic cable. Also a pair of fiber optic cables was lead to a room adjacent to that where the demos were displayed. This link brought connectivity to IDA, Mitre and the DSI terminal. For a schematic of the facility and relative location of the Hubs and LAN runs see Appendix D.

This year, the Local Area Network (LAN) was installed by Digital Equipment Corp. (DEC) under a government contract. The contract, however covered only cable and some labor. DEC donated the use of their smart hubs, hubwatch and datalogging equipment. The participants had voted to use 10Base T-connectors this year, which resulted in some limitations as to the availability of sophisticated network management tools. What it does have, however, as was displayed this year, is toughness. The basic coaxial cable was abused in every way, day after day, and rarely did a cable have to be repaired or replaced.

Fiber optic links were another matter. Due to the long runs between ballrooms and from the ballrooms to the display site, fiber was required. It satisfied the distance needs perfectly, but even with special measures provided to protect it from abuse (warning signs, barriers, etc.) there were several instances where the fiber was broken. Thanks to the professional wisdom and foresight of Digital, they had pulled extra fiber when installing the LAN so that they were able to assure connectivity quickly.

During the rehearsal and conference weeks several network issues were discovered. During rehearsal week there was a tremendous amount of confusion on how to install and configure the combined DIS and DoDDS network. The biggest problem was lack of communication between the DoDDS and DIS people and specifically a clear description of what the former needed. The temporary network concept was also misunderstood. IST had described it as temporary, intending only that everyone understand that the network would have to be reconfigured to the I/ITSEC show floor setup immediately after rehearsal week. Unfortunately, the temporary network was not provided with a network management workstation. IST expected the management workstation to have hub management and data logging software configured for debugging during the rehearsal. Presence of these tools could have speeded the overall process.

For the temporary LAN, Ethernet cables were labeled only at the hub end of the wire. During setup several cable labels fell off. This resulted in some of the cables being transposed among vendors. In retrospect, labeling the Ethernet cables with a numbering system at both ends, before the cable was installed, would have been helpful. After the cable was installed, it could have then been labeled at the patch panel by number and company name.

As IST reconfigured for Conference week in the more constrained booth area, it became evident that the network control center was very crowded and difficult to work in. We had underestimated the staff required to stay on-line to work through problems. Also, because of our proximity to the participants, problems were encountered when some participants attempted to reconfigure the network to meet their personal needs. Team members stayed on top of the situation however, so that these problems did not affect the final product.

Solutions to the Network issues should be easy to implement for IDEMO94. The network planning should be completed at least one week before rehearsals start. This year network changes were still being made right up until the cables were being installed.

One of the bright spots from IST's perspective was the support the Encore Computer Corporation provided in the form of network monitoring equipment and data logging during I/ITSEC '93. Encore provided 2 HP LAN Probes for network monitoring. The LAN Probes allowed IST to monitor types of network traffic, bandwidth utilization, and errors on the network. The Probes were also able to produce graphical representations of the data to further enhance IST's ability to support the I/ITSEC network.

7.1.2.2 LONG HAUL

There were eight organizations who chose to participate through long haul connection from remote sites. As mentioned earlier, most distant were the British Government labs who came in via a DSI link. DSI also carried the connection from the Army's Tank Automotive Command in Detroit. Several organizations elected to use leased T-1 lines to their booths, while still others used the lower bandwidth of public telephone lines to bring in input, rather than interactive participation.

In no cases were the long haul participants and their respective network links sources of problems. The only limitation, and one which should be avoided in the future, was the contention for time on the DSI connection. In this instance, it was contention between the DIS participants and the DoDDS schools, but the conflict affected both the test process and the rehearsal. This contention was not avoidable at the level of the DIS participants, including IST, as the decision to force us to share the resource was made in Washington.

7.2 REHEARSAL

Throughout the planning process the intent had been to set aside the week of 22 November (which included Thanksgiving Day) for the purpose of establishing performance capabilities and rehearsing the scenarios with individuals and groups. The expectation and understanding with the exhibition planner was that the DIS demo participants would have the rehearsal facility to themselves for the week. Further, it was agreed and voted upon that all testing had to have been completed one week before, except for network level checks.

The reality was quite different. The ability to rehearse as a group was non-existent until Sunday morning, seven days after we started set-up. Numerous causes contributed to this delay. They included:

- The exhibit people kept moving heavy equipment and exhibitors' goods through the rehearsal area (and over our LAN cables) creating significant disruptions. We succeeded in eliminating the heavy equipment problem early the second day.

- Testing of the individual simulators was far from completed. Also, none of the ancillary devices the players hung on the network in their booths had been tested and these were the source for much non-DIS traffic which caused problems. IST had offered to extend testing for the foreign participants into rehearsal week, expecting it could be done with minimal disruption. However, between their compliance problems and the rash of other tests required, testing had to be continued through Friday of rehearsal week.

- It took until midnight Wednesday to clean up the LAN traffic to the point where we could conduct preliminary exercises. Finding the sources for erroneous signals and helping participants solve their problems was labor intensive and time consuming.

- When the net was finally clean enough to support rehearsal, Thanksgiving was upon us and many individuals and groups left, not to return until Sunday.

- Throughout the week of rehearsal, and the following week as well, the Stealth used for displaying the demonstration crashed at frequent intervals. The first scenario carried through to completion did not occur until Wednesday night of the second week - literally the last rehearsal for the last demonstration of the Conference.

- From midnight Friday through 0800 Sunday the LAN and exhibitors had to be moved to the configuration they would be in for the conference, so test and rehearsal time was unavailable.

- There was contention for time on the DSI network and time on the Stealth arising from using the same facilities for the Department of Defense Dependent Schools demonstrations. This contention was particularly disruptive when trying to rehearse during conference week, because the rehearsals could only begin after the exhibit floor closed at 2000 which drove the DIS portion to 2230 - 2300 completions.

Rehearsal of the participants, in their conference settings and with the all-up network was started Sunday afternoon. The original timetable had called for the LAN to be reconfigured and ready to support play by 1800 but, due to the need to rehearse in coordination with some DoDDS related Video-Teleconferencing input, the schedule was moved forward to 1200. However, even though the network was up, there was no ability to rehearse the DIS participants through a complete scenario on Sunday. Even though the participants had previously been successfully networked before the move, once the net was up, with all players activated, erroneous outputs were once again present. Several hours were spent cleaning up the traffic. Once the DIS participants were ready, we moved into the mode of waiting for problems with the Stealth and the other demo to be resolved. Extensive time was spent Sunday evening waiting for a chance to rehearse the DIS participants, while the (only) Stealth operator was tied up in the rehearsal of the myriad other parts of the plenary presentation.

The first all-up dress rehearsal of the DIS demonstration was done Monday in conjunction with that of the Plenary Program which included related speakers and the DoDDS schools. Again, as on Sunday, there were few opportunities to rehearse the DIS players due to time consumed by related rehearsals and the frequent crashes and prolonged repairs to the Stealth. The period from 1630 to 2000 was lost, as the exhibit hall was opened to the public. After it was closed to the public further rehearsals were run. By about 2230 there was a general belief that the players were as prepared as they could be. Starting coordinates and tactics had been developed based on what the Stealth could show and the realities of moving the viewing audience across the sea, air and ground battle areas quickly enough to keep things interesting and fit the 10 minutes allocated to the presentation.

7.3 LIVE DEMONSTRATIONS

The initial demonstration was conducted as part of the plenary program, with all players live on the network. Even though the scenario had been finalized only the night before, the participants' execution was faultless. The DSI connections to the Army's Tank Automotive Command and to the three British Labs provided reliable connectivity for this, as well as the subsequent demos. The greatest concern in conducting the events live was the fear that corrupted traffic would appear which might cause large scale crashes on the net.

As it turned out, the traffic on the network was very well disciplined. All players, except the Stealth which was to display the program, were able to play their required roles. Fortunately, the crash of the Stealth occurred far enough into the demonstration that members of the audience were not aware of its loss, and were led to believe that the demonstration had reached its intended end.

The same thing happened the second day. The demonstration progressed as to plan, up until the premature crash of the Stealth. Again, the audience was generally not aware of the early failure, because most of the planned events had been completed. By this point however, all participants agreed that the third, and last, demonstration should be data logged ahead of time. Therefore, the rehearsal efforts (which ran from about 2030 to 2230 Wed.) were logged and used for the Thursday demonstration. Once again the Stealth suffered problems, but by logging the data the demonstration came across as successful.

8. OBSERVATIONS ON NETWORK TRAFFIC

A lot of interest was expressed in collecting data and performing analyses on the data that was to be produced at the time of the demonstration. A number of planning meetings were called involving several organizations, including IDA, IBM, Loral, and Encore. The result of these meetings was a preliminary set of measures of interest and logging format. Digital Equipment Corporation, contractor for design and implementation of the local area network for IDEMO93 was also contracted to record data. They logged all the data on the network (comprising both DIS and non-DIS network traffic) during the week of the demonstration. Encore Computer Corporation also volunteered to log data, starting the first day of rehearsal week. This data, comprising only DIS network traffic, was then given to IST for further analysis. In addition, Encore equipped IST with an Encore 91-Series multiprocessor and a part-time technical staff member to aid in the analysis and performance evaluation.

A preliminary set of measures was documented and is provided below. The data analysis will be of an iterative nature with several levels of detailed analysis. The final set of measures, procedures, and discussion of results will be produced and submitted as a separate document. The network traffic at IDEMO93 was composed of DIS as well as non-DIS packets. The first measure of interest is the traffic breakdown (per protocol) so the percentage network bandwidth consumed by DIS vs. non-DIS can be obtained. The DIS network utilization metrics of interest are the following:

A. Peak performance measures:

- DIS PDU-kind specific measures:
  - Issue rate (per site, per host, per entity-type)
  - Peak issue rate

- Entity type specific measures:
  - Measures for air entities

Measures for land entities
Measures for sea entities
Measures for munition entities

- Site specific measures:
  - Total number of PDUs generated
  - ESPDU rate for stationary vehicles
  - ESPDU rate for land vehicles
  - ESPDU rate for sea vehicles
  - ESPDU rate for air vehicles
  - ESPDU rate for munitions

- Host specific measures:
  - Total number of entities simulated
  - Frequency of the various PDUs

- Activity specific measures:
  - Single entity tracking
  - Time interval activity report

B. The "total traffic utilization metrics" consist of metrics performed on traffic consisting of DIS packets as well as other types of traffic. The measures of interest in this case are:

- Bandwidth consumed per protocol type
- Traffic breakdown per protocol type
- Issue rate of non-DIS traffic per generating source

During the two weeks of IDEMO93, a Probeview program monitored all aspects of the network at all times. At the time of writing, a detailed analysis of the logged data has not been completed, but a qualitative analysis was obtained from the preliminary analysis. Though there were three physical networks, the discussion provided below refers to the principal network which was used for scenario rehearsal and for the actual demonstration. Table 7 (Appendix 3) lays out the chronology of events taking place on the network. The network did not become functional until late on Monday, 22 November due to the time required to allow the placement of heavy equipment in the rehearsal hall before the LAN lines could be laid. Once in operation, it remained in use continually, except for the holiday and moving shutdowns.

Network utilization during the first demonstration on November 30, 1993 is shown in Figure 1 (Appendix 4). It can be seen that the total utilization (i.e. DIS traffic in addition to the non-DIS traffic) never exceeded 4% of the total ethernet bandwidth available. Figure 2 (Appendix 4) shows that during that same time the network traffic never exceeded 300 packets per second, and averaged about 200 packets per second during the demonstration.

8.1 DISTRIBUTED INTERACTIVE SIMULATION NETWORK UTILIZATION

In this section, the network utilization during the DIS exercises will be detailed. We will describe the network under the various activities that took place over the course of two weeks. Statistics provided relate only to DIS PDU traffic.

8.1.1 FREE PLAY

"Free Play" is a term that describes uncoordinated simulator activity on the network, where scenario management is ad-hoc at best. Free Play may occur when some organizations choose to interact with each other for purposes other than the main demonstration. Often these inter-organization mini-tests are conducted without explicit communication with other parties, leading to network traffic that can be at best described as "random". A typical breakdown of DIS traffic during hours of Free Play is given below. In fact, the numbers given are the actual statistics for the hour of 1800-1900 on November 30, 1993.

- Entity State PDUs 92.87%
- Signal PDUs 4.05%
- Transmitter PDUs 1.63%
- Emission PDUs 1.16%
- Fire PDUs 0.12%
- Detonation PDUs 0.11%
- Acoustic PDUs 0.04% (experimental)
- Collision PDUs less than 0.01%
- Message PDUs less than 0.01%
- Stealth PDUs 0.009%(experimental)

8.1.2 SCENARIO REHEARSAL

As one might surmise from Figure 3 (Appendix 5), "Network Traffic as a Function of Time of Day", rehearsal times on the two days shown were early morning, starting at about 0800 and again in the late evening, about 2000. Network activity increased during these scenario rehearsals, and accounted for heavy DIS activity early and late in the day. During Conference week rehearsals were conducted when the exhibition halls were closed for the public. The drops in DIS network traffic in Figure 3 reflects low utilization during the early hours of the day and mid-afternoons. Demonstrations conducted internally by several companies contributed to maintaining a significant level of traffic in the afternoons of the demonstration days.

8.1.3 DEMONSTRATION

The actual demonstrations were held over a period of three days, lasting from 3 to 6 minutes each, subject to the availability of the Stealth (making it difficult to define exactly when the demonstration occurred). The demonstrations on the first two days were conducted live, whereas the last demonstration was a playback of a rehearsal recorded the night before. Refer to Figure 3 for DIS PDU traffic during the live demonstrations. The live demonstration times were:

November 30, 1993:	1053 - 1057
December 1, 1993:	1240 - 1245

Figure 4, "DIS PDU Traffic, Day 3" (Appendix 6), shows an early morning spike of activity spurred by a rehearsal called for that morning. The low at 1300 reflects a need to keep all unnecessary traffic off the net while the data-logged playback of the demo was shown.

8.2 EXPERIMENTS INVOLVING NEW PDUs

Networks were reserved on a first-come first-served basis for additional experiments. Granting these requests was made possible by having three physical networks, one which was dedicated to the demonstration, one reserved for scheduled experiments, and one for administrative applications (such as file transfer, and electronic mail). There were two special interest groups which reserved time slots for experiments, in particular these were the Radio group and the Emissions group. Each of these experiments, and their effects on the network will be described in following sections.

8.2.1 EMISSIONS

The Emission PDU did not cause any serious problems. Transmission of updates appeared to follow set guidelines. The ad-hoc parametric data limited the identification of emitter systems. IST observed several incorrect usages of Emission PDU data fields. One source of Emission PDUs associated the tracked targets of a track beam with an accompanying search beam. One source was transmitting incorrect parameter indices. In one irregular incident, a source transmitted Emissions PDUs with incorrectly large beam count values.

8.2.2 RADIO

The only problem discovered with Radio traffic was PDU size. Several companies had not anticipated the large size of some Signal PDUs, and had not made their simulators' buffers large enough. The result was usually fatal until the simulators' buffer sizes were increased.

8.2.3 SIMULATION MANAGEMENT

Simulation Management (SIMAN) was originally planned to be part of compliance testing. IST was not supposed to implement SIMAN PDUs but to get sample traffic from an organization which had already implemented SIMAN. When IST received the first sample disk, it was empty. A second disk was received. On this the SIMAN files were unreadable because they were in a raw data format with no network protocol headers. By the time IST got this last disk, the test schedule was very full and IST had no manpower left to write a program to read and decode the PDUs. Therefore, IST had no Simulation Management PDUs to transmit for testing. IST informed all organizations of this problem at the planning meeting in October and told all to be prepared to accept SIMAN PDUs on the net at Rehearsal week. For those organizations issuing SIMAN PDUs, IST had previously modified the Data Logger and Scanner to log and view the contents of the PDUs. During the demo two companies used a subset of the SIMAN PDUs to communicate between their respective systems.

One organization used the SET DATA PDU to command their Stealth. An agreement was made with them to insure every organization using their stealth would use a bridge to keep the SET DATA PDU from going out on the demo network. A few other organizations also implemented the ability to be controlled by SIMAN PDUs. Most organizations either filtered the SIMAN PDUs or ignored them. On a couple of occasions, SIMAN PDUs from internal networks got out on the demo net. When this occurred, other organizations employing SIMAN found their systems would respond by doing what the SIMAN PDUs specified, such as START or STOP. When PDUs from a stealth using SIMAN got on the demo net, other like stealths on the net would respond to the command regardless of what their owners were doing at the time. From this experience it was learned that, if SIMAN PDUs are used next year, their use should be coordinated and agreed to by all participants.

8.3 EXPERIMENTATION ON THE DEMO NET

One of the most obvious benefits of IDEMO93 was the gathering of so many different DIS systems on one network. Prior to the conference, two meetings were held at IST to discuss the types of experiments that should be held on the net to take advantage of this situation. Representatives from various organizations were invited to suggest experiments and data recording methods. Below is a discussion of the experiments that were held on December 2, 1993, in the morning.

8.3.1 NETWORK FLOODING EXPERIMENT

A network flooding experiment was conducted with the assistance of two organizations: SAIC/Warbreaker and McDonnell Douglas. Their sources were capable of generating controllable, large volumes of PDU traffic so that their effects could be observed. The highest PDU rate sustained was 4000 Entity State PDUs per second. The test was conducted on December 2, 1993 from 1000 to 1030 and a total of 1,007,701 Entity State PDUs were logged, in addition to 10,095 other DIS PDUs, yielding an average of 282 DIS PDUs/second over the half hour (see Figure 4 - Appendix 6).

8.3.2 GRADUATED PDU TRAFFIC EXPERIMENT

Having a variety of systems on the network gave flexibility in the types of experiments and analysis that could be done. One experiment emphasized the bandwidth utilization of different types of PDUs. This experiment had different systems/entities come onto the net at different times according to the type PDUs produced by that system/entity. The purpose was to gradually increase the traffic on the network and examine the effects of each available entity type. The first participants were stationary land entities, followed by sea, air, radio, and emissions. After adding these entities, direction was given to begin increasing movement and commence firing by those capable. The resulting traffic was recorded for post demo analysis. Results are published in a separate IST report [IST-TR-94-14].

9. ISSUES AND RECOMMENDATIONS (LESSONS LEARNED)

As stated earlier, one of the principal reasons for conducting this demonstration annually is the opportunity it affords for a "reality check" on the DIS Standards, as they evolve. It is also a learning experience without parallel on the problems attendant to setting up a large network of heterogeneous simulators and simulations. Specific areas deserving further attention are described below.

9.1 DIS STANDARD

The IDEMOs continue to be an effective way to test and validate the DIS standards. A subset of both the PDU and Communication Architecture standards were proved at this year's demonstration. Last year, testing uncovered errors in the PDU standard - most associated with lack of specification. This year, however, the problems uncovered through testing were due primarily to interpretation - not errors in the standard.

Due to the inherent flexibility of the DIS standards, users have a choice of what options or policies to choose when planning their exercises. For example, in the PDU standard a user has a choice of dead reckoning algorithms, thresholds, and articulated parts - to name just a few. This flexibility can lead to incompatibility between systems if users have interpreted the policies differently. One instance of this at IDEMO93 was articulated parts. During the planning meetings it was decided that a maximum of two articulated parts would be allowed. During rehearsal week, one organization sent out Entity State PDUs with one articulated part. According to the planning meetings, this was allowed; however, some organizations interpreted that decision to be two or zero articulated parts. The fact that there was an entity with only one caused some systems problems. This type of interpretation problem was also found with the Set Data PDU for Stealth-PVD communication, Detonation and Deactivation, Enumerations, and the Extra Field in Entity Type Record, and Guise. The solution to this problem may be the creation of a DIS PDU Guidance document which discusses design and implementation issues, as well as policy decisions.

There were also minor problems associated with non-backward compatible versions of the PDU standard at I/ITSEC. Since version 1.0, the PDU standard has continued to change rapidly--always making non-backward compatible changes to the PDUs. However, now that this standard has been technically proven and has an installed base of 80+ systems, the Standards Workshops and the Steering Committee should strive to keep all future changes to the standard backward compatible.

We as a community are not helping ourselves by continuing to make major changes to the PDUs at every workshop. As companies make investments in DIS technology, we should be fostering future development - not making those companies re-invent what they have already invested in. We should be encouraging the community to "tinker" with the new PDUs (e.g., SIMAN, Emissions, Radio, Acoustics, ...), so that DIS continues to expand. We have only touched the surface of what is possible. By continually changing the known installed base, we risk pushing people away from DIS and future development. Eventually, there will be issues which warrant non-backward compatible changes to the PDU standard, but for now we should be careful in what we change and make every attempt to keep the standards stable so that we can grow in numbers and in experience.

9.2 NETWORK

There are really two network environments to consider in organizing a demonstration such as at the I/ITSEC. One is the long distance Wide Area Network, where problems, should they arise, usually require assistance from outside the IDEMO environment. The other is that of the relatively controllable, readily observable Local Area Network, where problems that arise can be addressed quickly. Comments on each are provided, as the problems tend to be unique to each.

9.2.1 WIDE AREA NETWORK

The participants who came into the demo via a long haul connection present a unique set of problems from the standpoint of coordination of events and timing if they must be correlated with others on the same event. A capable liaison person at the site of the demo, in close contact with the remote site is an imperative. For those who participated over the various telephone connections (T-1s, 56k datalines, etc.) that was the primary challenge.

Those who used the DSI to participate had an additional problem. This linkage is heavily scheduled and committed. On occasions when we had problems with events at the site that caused delays or schedule changes, DSI was not always able to accommodate the change. The relative inflexibility of this WAN access demands a much tighter control over schedule than was possible during IDEMO93 to insure against serious rehearsal problems.

9.2.2 LOCAL AREA NETWORK

There were no design problems with the network and IST would recommend using the same approach next year. Those problems that did involve the network revolved around logistics. The contractor was not ready to install the fully functional temporary network on the first day of rehearsal. A primary cause was the late recognition by all planners that multiple networks would be required. This, in turn, required additional hubs and the addition of patch panels; items that had to be ordered from elsewhere and were late coming. As a result, during the practice week we were short on racks, patch panels, and hub modules. The contractor also ended up having to use that week to configure his network diagnostic tools. With these complications, it was difficult to administer the network during rehearsal.

It was afternoon on the first day of rehearsal before the freight traffic slowed down enough to pull the cables. The vendors really were not ready to accept the network connection until late in the afternoon. This will be a timing reality any time a cabled network and heavy equipment are combined.

More cable was cut during the time when the exhibits were moved into their permanent locations, when the empty crates were taken out. More networking staff is needed at this time to watch over the cable and to instruct the workers to be careful around the cable.

The configuration of the network should be frozen 1 week before the show. There must be better coordination between all users of the network (e.g. DoDDS, IDA and IST this year) to support an overall network design from the top down.

A tear down plan needs to be established so that we can salvage as much of the cable as possible. The riggers from the hotel can not be counted on for anything but pulling the cable. Several people need to be there to support the riggers to keep it from tangling. The first time fiber optic cable was pulled from the Palm Ballroom to Room 14 it ended in a mess and had to be repulled. It took several hours of work to straighten it out.

9.3 FUTURE COMPLIANCE TESTING

As mentioned earlier, DIS compliance testing was performed on Demo participants prior to IDEMO93. It began August 27th and continued until November 19th. It resumed again during the "practice" week prior to I/ITSEC and effectively continued throughout the conference as additional problems were uncovered.

It was suspected before, and very obvious after IDEMO92 that compliance testing was essential. The IDEMO92 experience showed that not a single organization had come to the gathering in a state of complete readiness. It also pointed out the need to begin testing much earlier. That was done for IDEMO93.

During the 1992 demonstration it appeared that the prior week's compliance testing had been sufficient. Most systems worked well together and very few had noticeable problems. The 1993 Demo showed a different result. The prior testing had obviously been necessary. It had not, however, been close to sufficient. "Compliance" Testing had been the goal. Whether or not that succeeded, it quickly became obvious that "Interoperability Testing" had not been accomplished.

One of the most significant roadblocks to development of procedures to test for the existence of "Interoperability" is the lack of a working definition. Generation of a final definition is not attempted here but a number of likely aspects will be mentioned.

There is general agreement that Interoperability involves the existence of robust, long term, and meaningful interaction between the interacting systems. The systems should operate together without crashing as a result of trivial problems. If they cannot all be made to generate "perfect" output, then they should all be able to tolerate vagaries and anomalies in the simulation data. They should continue to operate for as long as is needed for the application. They should understand each other completely.

As was done in the development of compliance testing procedures, a "philosophy of testing" is needed. The compliance testing philosophy indicated a graduated series of tests working upward from the lowest levels of network connectivity though the protocol stack to the application level. An interoperability philosophy might use the same scheme. Begin with a very simple form of interaction, i.e. unidirectional transfer and interpretation of data, verify that it is accomplished, then attempt interaction in which simple responses are generated and examined for appropriate content and temporal position. More complex responses would follow and finally, multi-step interactions (As complex as those involved in tracking and hitting a moving target or coordinating a transfer of supplies) would be exercised.

These tests would need to examine the interactions to determine that the behavior was appropriate and complete, that it was accomplished within a reasonable time frame, and that it was robust. Tests for robustness should attempt to determine the likelihood that the simulations can continue or pick up after an error. The philosophy, its procedures, and the tools which will be necessary must be developed early in 1994 to provide this capability at the beginning of the next I/ITSEC effort.

Based on past experience, development of the specifics of these tests will point out more aspects of the use of the DIS Standard that are not defined or are vague or ambiguous. When this happens test developers have traditionally consulted with other implementors and with members of the DIS Standards Project. In some cases these questions could not be resolved and decisions had to be made by those writing the tests. When this has happened, such decisions were seldom questioned until they were made apparent by the detection of the "alternative" interpretations of an ambiguous point. Then the decision was reviewed and sometimes changed. Such cases have provided useful input into the standards development process.

Further observations on future compliance testing, from the IST staff perspective, include:

Compliance testing was done this year and last. It is a necessary aspect, but is not sufficient. Testing for realistic INTEROPERABILITY was needed, but did not happen. Tools and procedures must be developed in early 1994 to provide this capability.

Although technically "prohibited", all sorts of non-DIS traffic continued to find its way onto the network Interoperability tests and on-line diagnostics are needed to detect the source of this traffic.

Participants interpreted prohibitions and regulations to their convenience (e.g. using VR-Link features that had not been tested or validated, such as Stealth control using SET DATA SIMAN PDUs). These PDUs were broadcast at high rates and were sent without identifying a target Stealth, resulting in control of devices other than those intended. The capability needs to be developed to test for emission such as this, both to detect their presence and to generate such outputs to assure that other participants can survive their presence.

A working definition of "INTEROPERABILITY" will be needed before a reasonable attempt can be made to develop tests to determine the level of interoperability that a system can support.

At a minimum, interoperability tests will have to determine that a system, once tested for strict compliance with the standard, can interact with another such system:

- for extended periods of time
- without crashing
- without losing data
- without corrupting other systems

10. FINDINGS

The following section attempts to capture the thoughts and statements of the participants and the IST testers and organizers regarding the things that might be/should be done to make the IDEMO better, next time. The input is segregated by source in the following sections.

10.1 HOT WRAP

The following information is a compilation of notes from the post-demo "hot wrap" meeting held after the last demonstration the afternoon of 2 December. These minutes are re-created as distributed to participants in December 93.

"The purpose of the after-action review meeting was to share ideas and thoughts on the interoperability demonstration and the lessons learned from it, to voice any praise or disapproval on how the entire process was carried out, and more importantly, to provide constructive criticism on how things should be handled differently in the future. A survey has been distributed to all participants to gather information concerning the design process, testing, and the preparation towards the final demonstration. It was asked that all the participants write a short synopsis about the obstacles encountered, experience gained, the time and manpower it took to bring their software and equipment to participate in this year's demonstration. This synopsis is an attempt to learn from each other's experiences and it was asked that the participants be candid and frank. The source of the comments was to be kept anonymous. These comments are to be integrated into a report which would be distributed to all participants.

A technical report is also to be distributed by PRC (Project 2851) based on responses to a survey they are conducting on the SIF database. This report is expected to be out by the holidays.

After these few opening comments, the floor was opened to all the demo participants to voice any comments on the interoperability demonstration. The first question which was asked was whether everyone was tested, to which the answer was affirmative. When asked about the tests for terrain database correlation and use of the rule of one-sixth, Jim Williams admitted that the rule had been waived during the demo since IDA complained that they needed aircraft closer to the ground to show the battle in an interesting fashion.

IDA was the first to volunteer to feed back to the group the lessons learned and indicated that they would assemble their observations and send them out to all participants.

IBM commented positively on the overall good network organization and support by DEC. They also suggested the utility of a Stealth PDU which could be broadcast in order to position all Stealths to the same point of view.

Lt. Colonel Bartlett then thanked everyone for their participation, and expressed his pride and appreciation for the effort every participant had put into the demonstration. He emphasized that despite the problems encountered, that the group should focus on the solutions rather than the problems.

The discussion then looked at the presentation of the demonstration. An observation was put forth that the group had grown to such an extent that a single presentation could not handle everyone effectively. The suggestion was offered to break into smaller groups in the future, each of which would then try to figure out the capabilities on a per group basis. It was then suggested instead that the change should occur in the manner in which the DIS technology is presented. By orchestrating smaller scenarios, the audience would be able to follow more closely what exactly was happening. It was stated that what was visible on the Stealth in the main ballroom was not even one tenth of what was going on in the battlefield.

The point was brought up that back-up Stealths are needed next year, or that multiple Stealth be used and that there be video-switching amongst several Stealths. The rehearsals were very tedious and frustrating due to the long waits in between rehearsals, it was particularly frustrating for the long-haul participants such as the UK players.

IDA thanked the Concurrent Computer Corporation and Evans and Sutherland for their effort and desire to set up the new Stealth, for they "busted their asses to make things work...". IDA observed that terrain correlation remained a problem, and that more models and accurate models need to be represented. One way of making things better for the next time around is to start developing a Stealth earlier, in January instead of six weeks prior to the show.

Scott Smith (IST) then suggested that instead of having a central focus (i.e. main ballroom/one big picture) that the focus be distributed to individual booths. Each booth may choose its own equipment and way of bringing the show to life, be it visually, through audio, or using radar displays. After all, DIS is distributed simulation.

We need to get the audience more involved in the demonstration. Not only was it unclear to most of the audience what was going on during the demonstration, they were unaware of the fact that a lot more was going on besides what meets the eye. The vehicles were never identified, and playbacks of the same scenario showing different snapshots of the battle, would leave the audience fascinated, but only if they manage to see this in the individual booths of some companies. By shifting the emphasis to individual exhibitors' booths, each company is responsible for impressing their own customers, and the reliability of both software and hardware would be distributed as well.

The group was reminded that the problems encountered be fed back to the Standards' committee. The problems of coordinate conversion and the ambiguous interpretation of Dead Reckoning algorithms were noted. Position Papers were invited for submission to the DIS Standards Workshop on anything found during preparation or conduct of the network demonstrations.

The emphasis this year was again on the Stealth for visualization of the participants equipment instead of other means of display, such as radar. Viewing is not the only way of "looking at" DIS and next years event needs to explore options. Providing multiple views of the same battlefield, such as seen from different vehicles, would be a good way to present the information to people, it was suggested.

The observation was made that the Marriott facility imposes significant limits on what can be shown and how many can be brought in to view the demonstration. What about next year? It will be the same time next year, only one day earlier. The main problem is the availability of the Marriott for two consecutive weeks and the scheduling of the I/ITSEC conference again the week after Thanksgiving.

Attendees voted to use Hunter Liggett again for next year's demonstration. There may or may not be DSI access in the near future, but definitely future testing should involve multiple systems instead of only one test system, to run mini-scenarios. From a testing point of view, in addition to testing software, hardware, bridges, and routers need to be tested also. Too much time was spent debugging systems after the participants plugged into the net in Orlando.

Suggestion was made that scenarios should be done by June 1994, and this date should be a hard date, and not a rolling date such as there has been this year. It was then noted that the scenario depends on the capabilities of each system, and on its availability and finalization normally has to await other outcomes.

Simulators should be built to handle all sorts of traffic which may not necessarily be DIS. IST committed to test participants against a wide variety of erroneous data next year, since this was such a killer this year.

One of the problems raised was that as a new player on the net, it was hard to imagine what to expect. Perhaps it would be a good idea to provide logged data to these new players. Distributing the logged data may not prove useful for next year players since there will be a new standard by then which may not be backward compatible to DIS 2.0.3.

Another problem was the delivery date of the terrain database. An earlier date would help, should we change from FHL.

The standard needs to be followed, in particular with regards to the dead-reckoning algorithms. If it needs clarification, push the issue at the workshop.

Nan, who played the Television newscaster, then made a comment that she got great feedback from several people from the audience about the quality of the demonstration, so she applauded the participants and congratulated them on a job well done.

Communication using electronic mail was emphasized, since a lot of things need to be resolved before the next workshop. Also, for the next demonstration, the power requirements should be accurate and issued long ahead of time, in order to provide for all the equipment. The participants were then reminded to send in their comments within the next two weeks to Jim Williams, after which the meeting was adjourned.

Ed Ward, next years program chairman indicated that the planning for next years I/ITSEC program (and demo) would begin in early January and he intends to set up a special team to manage the effort on behalf of the Conference committee.

In addition to the comments offered during the meeting, the following were provided subsequent to that event:

There is a fundamental gulf between the needs of a "demonstration" and those of using DIS for "real-world" applications. For demonstrations there is a desire to group participants tightly - to show a full screen of activity. In the real world military combatants are widely separated. In demonstrations to date there has been no way to be interested by things one cannot see, yet these may be of critical interest in reality. These realities create natural friction between legitimate tacticians and demo presenters and threaten the credibility of the whole demonstration, depending upon the background of the audience. Next year we must go into the demo design process early, starting with a clear agreement as to who we wish to impress and what the "real" purpose of the demonstration(s) is (e.g. show new technology, show new customers of DIS, use as educational media etc.).

Last year we had 20 organizations and 18 simulators participating in the demo, this year there were 47 organizations and 70+ simulators. The exponential growth in participation was accompanied by chaos at times. The rehearsal week seemed to be unwieldy.

Next year Radio and SIMAN PDUs should be required for participation in the demo. The Radio PDUs could be used to coordinate the activities of the different organizations. This year, since we were in three rooms, communication via walkie-talkie was not effective as instructions had to be relayed to the Palms from the Stealth control center. We had many problems this year with systems/entities producing bad data or not responding to requests to clean up their traffic. Using Simulation Management, IST would be able to control the exercise and organizations not complying with standing policies or requests.

There were numerous instances this year of the tag falling off the cable or cables being tagged wrong. By labeling the actual cables with a permanent marker, no mistakes/confusion will occur.

There need to be logs kept of bugs and problems. On Wednesday night of rehearsal week when "bad data" was found on the net, IST should have been documenting everything found. Not only so they would know where the problems came from (for future reference since most of the problems would not be resolved immediately, and would reappear when systems booted up the next day) but also so they could be added to each company's test files. Documenting the bugs would allow IST to monitor the known problem producers and not let them back onto the scenario network until they had "passed testing."

There is a desperate need for better communication between all involved parties of the demo. This year there seemed to be major communication gaps between IST, IDA, and the participants. We need to better define the responsibilities of each party involved and foster an environment for open communications. There needs to be an individual who is in charge and who can render on the spot decisions!

There was talk at the hot wash meeting of earlier dates for testing and scenario practice. Reality does not always make this possible. The participants can not begin scenario practice until they have been tested; the participants cannot be tested until the test documents are completed; the test documents cannot be updated until the decision has been made on which version of the PDU standard to use. And, if the version selected is non-backward compatible -- it takes everyone much longer to re implement, delaying the entire process. If everyone could begin implementing just the new PDUs (e.g., radio and SIMAN), then some scenario practice can already begin since companies have passed testing for the basic PDUs. Additional testing will be required for radio and SIMAN but that won't hold up scenario practice. We can have group SIMAN and radio testing as the year progresses."

10.2 RESPONSES TO THE IST DEMO PARTICIPANT QUESTIONNAIRE

Shortly after the demonstration was over, IST distributed a questionnaire to those who had been involved in the planning process. Its purpose was to gain feedback on the conduct of the effort and seek information on how to improve future events. Though nearly fifty organizations were on the network and even more were involved peripherally, only twenty-one responses were received. The questionnaire itself is reproduced in Appendix E with the responses indicated below each question.

10.3 RECOMMENDATIONS FOR THE FUTURE DEVELOPMENT OF THE TESTBED

If the DIS TESTBED is to be used to facilitate future Interoperability demonstrations, a number of currently existing capabilities must be greatly enhanced and several new ones must be invented and developed.

Compliance and Interoperability testing must be started earlier. In fact, they must be ongoing. IDEMO93 was only one of many tasks assigned to IST's project, albeit the largest one. The TESTBED has been set up with other tests and evaluations in mind. A way must be found to provide the full range and scale of testing year-round. Suggestions received after the last demonstration included conducting continuous exercises, over long periods of time, outside the time frame of I/ITSEC itself.

Testing must take place before an event such as IDEMO93, but during the event a process of monitoring should take place and this monitoring should be combined with mechanisms to control participation in the event that circumstances deteriorate. Monitoring DIS in real time will require on-the-fly examination of the PDUs for data ranges and types.

10.3.1 PREPARATORY TESTING:

Testing must accommodate much greater bandwidths. A single Toll-free dial-up line cannot handle more than 3 or 4 active entities. Logged Testing will become unwieldy at a slightly higher threshold. Physical transport of simulators to IST is a luxury few can afford. Access to the DSI is difficult, rationed, and expensive. Solutions which come to mind include:

1. Taking the testing setups to the systems instead of vice versa. IST is planning for this case.

2. Development of the test setups to allow them to operate on a wider range of equipment types to increase the number of facilities which might be able to run them on their own equipment.

3. Development of remote communications links which employ a number of dial-up lines in parallel to multiply the effective throughput.

The existing test tools must be enhanced to increase the completeness and efficiency of the testing that is done before a demo to assure readiness.

1. Test systems for their capability to resist or reject the receipt of erroneous traffic. Despite previous exhortations to the contrary and testing of individual systems to determine that only legal traffic was generated, a significant percentage of the participants continued to place non-DIS, non-Point-to-Point traffic on the net. Some even placed new, untested equipment on the net. The reality of such a volunteer effort is that systems are going to have to protect themselves. Participants will need a way to test the effectiveness of their prophylaxes.

2. Automate testing to the greatest extent possible. Compliance testing during the last two years has required a significant amount of tedious labor, in some cases a field by field visual examination of a PDU. Some of the tests require several minutes of operator time per PDU. It simply is not feasible to manually test the hundreds or thousands of PDUs generated by a simulator during compliance testing.

In addition to low level compliance tests there is a need for much more complex examinations of the relationships between different PDUs or the fields in them. A few examples are:

- Automated tests for consistency between the locations, velocities, and timestamps in all the entity state PDUs generated by one moving entity.

- Automated consistency checks between pairs of FIRE and DETONATION PDUs.

- Automated checks for clear line-of-sight between firing and target entities to verify that a hit was reasonable.

- Sequencing checks to be sure that LOGISTICS PDUs are used in order and to transfer realistic quantities in real times.

The capabilities statement must be expanded to include many aspects of simulator performance: entity maximum speed, maximum turn rate, etc., so that tests can check the simulators against these bounds during testing.

IST should send a diskette or use E-mail to companies which are going to participate in compliance testing. IST should provide an electronic form for registering all of their SUTs and all of their SUT capabilities. Also included should be a program which the company can use to interactively test the basic elements of their simulator: Ethernet, IP, UDP, basic PDU syntax, etc., so that they will be prepared when they begin formal compliance testing.

Test tools should log their results into a database. This should be a relational database which can be joined with the capabilities database which contains SUT capability information. Such a database would allow automatic scoring of simulator performance. A database report could then generate a list of all currently compliant simulators, and what areas of the standard they are compliant in. Reports could be E-mailed to the companies.

We need an automated/on-line phone log system. Any calls related to testing should be immediately logged in a database on the nearest computer.

All of these databases should be stored on a central fileserver which is accessible from any computer in the TESTBED lab or in any office.

10.3.2 MONITORING AN EXERCISE

There are a number of capabilities which IST should develop to provide runtime indications of the quantity and quality of DIS network traffic.

A tool is needed to monitor DIS and NON-DIS data rates by ETHERNET address. Maximum allowable rates should be set by simulation management. Sustained bursts larger than the maximum rate should trigger a message to simulation management to slow down or shut off the simulators.

A greatly improved version of the NETWORK POLICEMAN is needed. The tool should examine every packet, in real time, and determine whether or not it meets all of the criteria specified for the exercise, including:

- correct selection of all underlying protocols supporting the transmission of DIS application PDUs.
- membership in the classes of non-DIS packets allowed in the exercise
- correct and reasonable values for all fields within all protocol headers and the DIS PDUs.

We need a mechanism to detect packets from "unregistered" Ethernet addresses. This would facilitate detection of new, untested systems which were placed on the net without authorization.

10.3.3 AUTOMATED TESTS

Both the preliminary compliance testing and the runtime network monitoring will require automated examination and verification of many aspects of the packets' contents. There will need to be components of the tools which can automatically verify:

(1) COMMUNICATIONS PROTOCOLS

Automatically verify the consistency of all aspects of all layers of the network protocols from ETHERNET through UDP. This includes verification that length fields match lengths of content, that fragmented packets are reassembled, that Ethernet addresses match up with IP addresses, etc.

(2) DATA VALUES

Automatically verify that the content of each DIS PDU field is within some predetermined set of bounds. The bounds should be read from a capabilities database which includes such information as maximum velocities for each entity, maximum angular velocities, and other entity specific information.

(3) COMMUNICATIONS

Automatically verify that a transmitter exists when any signal PDU is issued.

(4) ENUMERATIONS

Automatically verify that all enumerations in PDUs are correct. This includes FORCE ID, ENTITY TYPE, ENCODING TYPE, etc.

(5) DEAD RECKONING

Automatically verify the correctness of dead reckoning for every entity -- every time a PDU is issued by the entity.

(6) SLIPPAGE

Assure that an entity's orientation corresponds to the entity's velocity vector, within a tolerance established for that entity type. This tolerance could be large for entities such as Dismounted Infantry. Consideration must also be given to cases in which a destroyed entity is tumbling through space and unusual excursions would be expected.

(7) ARTICULATED PARTS

Automatically verify that the number of articulated parts on an entity is less than or equal to a predetermined maximum, that the parts codes are appropriate for the entity, and that values are internally consistent.

(8) DIS PDU HEADER

Automatically verify that the length of PDUs correspond to the values given for such fields as number of articulated parts, number of antenna beams, number of antenna parameters, number of samples in a signal PDU, etc..

(9) EVENT CONSISTENCY

Automatically verify that fire events correspond to detonation events. This involves matching event IDs, target IDs, firing entity IDs, timestamps, weapons types, results codes, etc. It would require verification that the fire location in a fire PDU corresponds to the firing entity's location and that the impact location in a detonation PDU was reasonable with respect to the terrain and target's location, attitude, velocities, munition type, etc.

(10) COLLISIONS

Automatically verify that the mass field in a collision PDU corresponds to the mass stated in the capabilities statement, that a single PDU pair results from a single collision event, that multiple, closely spaced collisions are accounted for properly and separately, that the world location of two colliding entities is within the bounding boxes of the colliding entities, that the impact velocity in a collision is close to the actual velocity of the colliding vehicle.

(11) EMISSIONS

Automatically verify emission PDU data are in bounds.

10.3.4 EXTENSIONS TO TOOLS

Other needed extensions to tools include:

(1) Automatically verifying that an entity is within a specified distance of the gaming area specified for testing.

(2) When prompted, verify that an entity is within a specified distance of a predetermined coordinate.

(3) Filtering by ETHERNET address, IP address, entity id, etc. to reduce the clutter for other tools, both runtime and off-line.

(4) Adding the ability to search by PDU type, entity type, PDU content in the SCANNER.

(5) More debugging aids in the CGF Simulator:

- Detonate a munition on any entity

- Create an entity which will follow any other entity, friendly or hostile
- Create the "perfect" missile dynamics and use it to kill any entity.

(6) We need a DIS Stealth which has all the necessary and useful attach commands:

- attach to entity and look at it from any viewpoint and any distance away
- attach to an entity and automatically attach to its missile when it fires a missile
- attach to an entity and view the battle from its viewpoint or from that of one of its articulated parts.
- The Stealth needs to have a sufficient number of models available to reasonably visualize any entity.
- The Stealth should be controllable from the simulator and be controllable by scripts of pre-logged Stealth PDUs.

(7) A tool to analyze the I/ITSEC data and extract from it EVERY PDU which has bad data or crashes our CGF. This logged file should be played back against SUTs. A conversion program should be written which will read a logged file of DIS 2.0.3 PDUs and play them back in whatever format is specified (DIS 2.04, DIS 3.00, etc..) The logged file should be used to bullet-proof our simulator and as part of the Interoperability testing suite.

(8) An automated Radio test tool which checks a stream of radio PDUs for consistency. Also needed is a voice-interaction test tool which supports Mu Law, CVSD, or whatever other conventions might be adopted.

(9) Analytical tools to extract from a logger file or PDU stream a list of all of the different entity types encountered, and their enumerations.

(10) Tools need to be developed with an emphasis on testing of all of the equipment hooked up to a SUT's local net. In particular, bridges and routers need to be tested for compliance. Bridges which cannot turn off RIP or other protocols should be disqualified. UNIX workstations need to be tested for active daemons.

(11) Attempt to develop test tools which work over the Internet. PDUs could be sent point to point over the Internet by SUTs. Responses would be sent back over the internet using E-mail or some other such mechanism.

10.4 ADDITIONAL RECOMMENDATIONS:

The conduct of the exercise needs to be planned for high reliability to insure that events happen when planned and in the manner planned. IDEMO93 was at risk constantly, because we overlooked a source of "single point failure"; the Display Stealth. This one device was our only window to the world and only one copy was available to support the preparation of the DIS demonstration. Frequent problems with it caused ripple down effects on overall preparation of the exercise, and could have caused a no-show of the Plenary session demonstrations. This needs to be avoided through design of the experiment in the future.

In order to eliminate this problem next year, the network requirements must be defined earlier, and must be simplified. Network equipment and supplies should be hot staged at least one week before rehearsal week. This equipment would include all hardware and software networking equipment. Hardware setup would consist of mounting all equipment in racks, including patch panels and labels. All cables should be precut and labeled at both ends with numbers. Software setup would include installing and configuring all software on the network management workstations, configuring the hub to support software switching of ethernet ports and configuring the LAN Analyzer software to diagnose trouble on the network. By doing this we would be assured the networking equipment would be ready to go on the first day of rehearsal week.

When the cables are laid down, they must be labeled on both ends with some kind of numbering system and company name. Companies swapped cables and ended up with the wrong cable. Company names on only one end of the cable will not work.

The network control center needs to have a booth large enough to support all the required equipment to manage the I/ITSEC network. It also needs to be in a separate booth isolated from participants. The booth should be large enough to hold the network monitoring equipment and have space for approximately 7 people to sit down and work.

During rehearsal week, rubber mats are required to cover all exposed cables that are in the fork lift traffic lanes. Next year, we can do a better job of laying cable down main aisle ways. Too often cables were run as the crow flies. While the need to protect cables was discussed with the exhibit manager numerous times, and protective measures were assured, the required covers were scarce and late!

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Appendix 1

Table 3

ENTITY TYPE FIELD VALUES FOR DIS DEMO
14th I/ITSEC, 1993

	Country	Cat	Subcat	Spec	#Art Parts	Model #
Platforms: Kind = 1						
Land: Domain = 1						
AT-T heavy tracked vehicle	222	9	5	0	0	36
BMP	222	2	1	0	2	28
Bus	225	7	14	0	0	24
Car, black civilian	225	6	0	0	0	34
Challenger MBT	224	1	3	0	2	34
LOSAT	225	2	3	1	2	23
M-1	225	1	1	0	2	30
M-2	225	2	3	0	2	22
MCV-80 Warrior AFV	224	2	7	0	2	33
MT-LBU tracked vehicle	222	2	7	17	0	36
977 HEMTT	225	7	2	0	0	25
NLOS/Avenger	225	6	1	0	2	31
Patriot launcher	225	5	5	0	1	11
Patriot Radar Trailer	225	7	12	0	0	25
SA-2 Fan Song radar trailer	222	6	8	0	0	25
SA-3 Low Blow radar trailer	222	6	9	0	0	25
SA-6 Launcher	222	4	19	0	0	36
SA-6 Straight Flush radar	222	8	10	0	0	36
SA-8 Launcher/radar	222	4	41	1	0	36
SA-10 Flap Lid radar	222	7	38	1	0	25
SS-1 Scud Launcher	222	4	10	0	0	36
T-72	222	1	2	1	2	27
Tank, Virtual Prototype	225	1	5	0	2	32
ThAAD Launcher	225	5	6	0	1	37
TOC (M577)	225	6	2	0	0	38
Truck, generic	225	7	0	0	0	25
ZIL-157 truck	222	7	6	0	0	25
ZSU-23/4	222	4	18	0	2	39
ZSU-30	222	4	23	0	2	39
Air: Domain = 2						
A-50	222	9	1	1	0	4
AH-1W	225	6	2	3	0	2
AH-64	225	6	1	0	0	5
Biplane	225	55	5	0	0	42
C-130	225	4	1	0	0	4
EA-3B	225	53	2	2	0	1
F-15E	225	1	7	0	0	6
F-16	225	1	3	0	0	8
F-16C	225	1	3	3	0	8

	Country	Cat	Subcat	Spec	#Art Parts	Model #
F/A-18	225	1	15	0	0	7
KC-130	225	4	7	0	0	4
Mi-24	222	6	2	0	0	13
MiG-23	222	1	5	0	0	15
Platform: Kind=1 (cont.)						
Air: Domain=2 (cont.)						
MiG-29	222	1	2	0	0	16
OH-58	225	51	1	0	0	3
RAH-66	225	6	3	0	0	10
UAV	225	54	0	0	0	12
V-22	225	4	8	0	0	1
X-31	225	30	0	0	0	35
Surface: Domain=3						
CG-47 Aegis Cruiser	225	3	1	1-5A/R	0	18
CV-59	225	1	4	1	0	20
FFG-7	225	6	1	1	2	21
LHA	225	54	1	1-5A/R	0	17
Subsurface: Domain=4						
MOSS	225	51	2	0	0	N/A
SSBN Ohio Class	225	1	11	0	0	19
SS Tango Class	222	2	20	0	0	19
UC-1M	222	51	1	0	0	N/A
UC-2M	222	51	2	0	0	"
UC-3M	222	51	3	0	0	"
UC-4M	222	51	4	0	0	"
UC-5M	222	51	5	0	0	"
UC-P-1M	222	51	6	0	0	"
Munition: Kind=2						
Other: Domain=0						
Post Intercept Fragments	225	2	1	0		41
Anti-Air: Domain=1						
20mm	225	2	1	0		N/A
AA-3 Anab	222	1	3	0		43
AA-9 Amos	222	1	9	0		43
AIM-7 Sparrow	225	1	13	0		43
AIM-9 Sidewinder	225	1	1	0		43
AIM-9M Sidewinder	225	1	1	1		43
AIM-54 Phoenix	225	1	8	0		43
AIM-120 AMRAAM	225	1	2	0		43
FIM-92A Stinger	225	1	15	0		43
MIM-104 Patriot	225	1	16	0		14
RIM-7 Sea Soarrow	225	1	12	0		14
SA-2 Guideline	222	1	13	0		14
SA-3 Goa	222	1	14	0		14
SA-4 Ganef	222	1	15	0		14
SA-6 Gainful	222	1	17	0		14
SA-8 Gecko	222	1	19	0		14

	Country	Cat	Subcat	Spec	#Art Parts	Model #
SA-10 Grumble	222	1	21	0		14
ThAAD	225	1	20	0		14
ZSU-30 AAA	222	2	2	0		14
Anti-armor: Domain=2						
25mm	225	2	1	0		

Munition: Kind=2 (cont.)

	Country	Cat	Subcat	Spec	#Art Parts	Model #
Anti-armor: Domain=2(cont.)						
30mm	222	2	2	0		N/A
105mm	225	2	3	0		"
120mm	225	2	4	0		"
AGM-65 Maverick	225	1	4	0		43
AGM-65D Maverick	225	1	4	1		43
AGM-114 Hellfire	225	1	3	0		43
BGM-71 TOW	225	1	1	0		43
FOGM	225	1	8	0		43
LOSAT	225	1	7	0		43
Anti-Guided Munition: Domain=3						
ADC-Mk 1	225	1	1	2		N/A
ADC-Mk 2	225	1	1	3		"
NAE	225	1	1	4		"
UC-1S	222	1	3	1		"
UC-2S	222	1	3	2		"
UC-P-1S	222	1	3	3		"
Antiradar: Domain=4						
AGM-88 HARM	225	1	1	0		43
Antiship: Domain=6						
Mk 48 Torpedo	225	1	6	0		N/A
RGM-84 Harpoon	225	1	1-4	0		14
Antisubmarine: Domain=7						
E-53-71	222	1	5	2		N/A
E53-83	222	1	5	2		"
ET-80A	222	1	5	1		"
Mk 48 Torpedo	225	1	2	0		"
Antipersonnel: Domain=8						
7.62mm	222	2	2	0		N/A
	224	2	1	0		"
	225	2	2	0		"
Battlefield Support: Domain=8						
SS-1 Scud	222	1	10	0		14
Battlefield Support: Domain=9						
2.75-in rocket	225	2	19	0		N/A
20 mm	225	2	1	0		"
25 mm	222	2	3	0		"
30 mm	225	2	3	0		"

	Country	Cat	Subcat	Spec	#Art Parts	Model #
105 mm	224	2	3		0	"
105 mm	225	2	10		0	"
120 mm	222	2	15		0	"
120 mm	225	2	11		0	"
BGM-109 Tomahawk	225	1	6		0 1=booster, no wings 2=wings, no booster	14

Munition: Kind=2 (Continued)

Bomb: Domain=12

	Country	Cat	Subcat	Spec	#Art Parts	Model #
CBU	225	2	1-7		0	N/A
Mk-82	225	2	9		0	"
Mk-84	225	2	11		0	"

Life Form: Kind=3

Land: Domain=1

	Country	Cat	Subcat	Spec	#Art Parts	Model #
Dismounted Infantry	NNN	1	1-13			29

Appendix 2

TABLE 4

ENTITY-INTERACTION MATRIX FOR LAND PLATFORMS

6 Oct 93

	2.75-in rocket	7.62 mm	20 mm	25 mm	30 mm	105 mm	120 mm	AGM-65 Maverick	AGM-88 HARM	AGM-114 Hellfire	BGM-71 TOW	BGM-109 Tomahawk	CBU	FOGM	LOSAT	Mk-82 Bomb	Mk-84 Bomb	SS-1 Scud
AT-T heavy tracked vehicle	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BMP	X			X	X	X	X	X		X	X	X		X	X	X	X	X
Bus	X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
Car	X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
Challenger MBT						X	X	X		X	X			X	X	X	X	X
LOSAT	X			X	X	X	X	X		X	X	X		X	X	X	X	X
M-1						X	X	X		X	X			X	X	X	X	X
M-2	X			X	X	X	X	X		X	X	X		X	X	X	X	X
MCV-80 Warrior AFV	X			X	X	X	X	X		X	X	X		X	X	X	X	X
MT-LBU tracked vehicle	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
M977 HEMTT	X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
NLOS/Avenger	X		X	X	X	X	X	X		X	X	X		X	X	X	X	X
Patriot launcher	X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
Patriot radar trailer	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SA-2 Fan Song radar trailer	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SA-3 Low Blow radar trailer	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SA-6 launcher	X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
SA-6 Straight Flush radar	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SA-8 launcher/radar	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SA-10 Flap Lid radar	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SS-1 Scud launcher	X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
T-72						X	X	X		X	X			X	X	X	X	X
Tank, Virtual Prototype							X	X						X	X	X	X	X
ThAAD launcher	X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
TOC (M577)	X			X	X	X	X	X	X	X	X	X		X	X	X	X	X
Truck, generic	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ZIL-157 truck	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ZSU-23/4	X			X	X	X	X	X	X	X	X	X		X	X	X	X	X
ZSU-30	X				X	X	X	X	X	X	X	X		X	X	X	X	X
Dismounted Infantry	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X

Please review, circle any X=kill intersection, and return with rationale for nonconcurrence. Fax to Dan Mullally @ (407) 658-5059.

ENTITY-INTERACTION MATRIX FOR AIR AND WATER PLATFORMS

6 Oct 93

	20 mm	AA-3 Anab	AA-9 Amos	AIM-7 Sparrow	AIM-9 Sidewinder	AIM-54 Phoenix	AIM-120 AMRAAM	FIM-92A Stinger	MIM-104 Patriot	RIM-7 Sea Sparrow	SA-2 Guideline	SA-3 Goa	SA-4-Ganef	SA-6 Gainful	SA-8 Gecko	SA-10 Grumble	ThAAD	ZSU-30 AAA	RGM-84 Harpoon	Torpedoes, all
A-50	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
AH-1W	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
AH-64	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Biplane	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
C-130	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
EA-3B	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
F-15	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
F-16	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
F/A-18	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Mi-24	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
MiG-23	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
MiG-29	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
OH-58	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
RAH-66	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
UAV	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
V-22	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
CG-47																			X	X
CV-59																			X	X
FFG-7																			X	X
LHA																			X	X
SSBN Ohio class																			X	X
SS Tango class																			X	X

Please review, circle any X=kill intersection, and return with rationale for nonconcurrence. Fax to Dan Mullally @ (407) 658-5059.

Appendix 3

TABLE 6
CHRONOLOGY OF NETWORK USE

DAY NUMBER	TIME	ACTIVITY
Monday - Wed. Rehearsal Days Number 1 - 3	11/22/93 6:00 PM - 11/24/93 6:00 PM	Compliance Testing and Free Play
Wed. - Thurs Rehearsal Days Number 3 - 4	11/24/93 6:00 PM - 11/25/93 2:00 PM	Scenario Rehearsal of Day 1 and Testing
Thanksgiving!	11/25/93 2:00 PM - 11/26/93 8:00 AM	Testing, Holiday, Free Play
Friday Rehearsal Day Number 5	11/26/93 8:00 AM - 11/27/93 12:30 AM	Scenario Rehearsal of Day 1
Saturday Moving Day	11/27/93 12:30 AM - 11/28/93 12:00 PM	Network Down for Show Setup
Sunday Rehearsal Day Number 6	11/28/93 12:00 PM - 11/28/93 6:00PM	Free Play
	11/28/93 6:00 PM - 11/29/93 12:00 AM	Scenario Rehearsal of Day 1
Monday Rehearsal Day Number 7	11/29/93 12:00 AM - 11/29/93 8:00 AM	Free Play, Break
	11/29/93 8:00 AM- 11/29/93 4:30 PM	Scenario Rehearsal of Day 1, Free Play
	11/29/93 4:30 PM - 11/29/93 8:00 PM	Free Play, Break
	11/29/93 8:00 PM - 11/29/93 11:00 PM	Dress Rehearsal for Demonstration 1
	11/29/93 11:00 PM - 11/30/93 8:00 AM	Free Play, Break
Tuesday Demo Day Number1	11/30/93 8:00 AM - 11/30/93 10:30 AM	Dress Rehearsl for Demonstration1
	11/30/93 10:30 AM - 11/30/93 11:00 AM	Demonstration for Day 1
	11/30/93 11:00 AM - 11/30/93 12:00 PM	Free Play
	11/30/93 12:00 PM - 11/30/93 4:30 PM	Exhibit Hours
	11/30/93 4:30 PM - 11/30/93 6:00 PM	Free Play, Break
	11/30/93 6:00 PM - 11/30/93 8:00 PM	Exhibit Hours
	11/30/93 8:00 PM - 11/30/93 11:00 PM	Scenario Rehearsal for Day 2
	11/30/93 11:00 PM - 12/01/93 8:00 AM	Free Play, Break

Wednesday Demo Day Number 2	12/01/93 8:00 AM - 12/01/93 10:00 AM	Scenario Rehearsal for Day 2
	12/01/93 10:00 AM - 12/01/93 12:00PM	Exhibit Hours
	12/01/93 12:00 PM - 12/01/93 12:30 PM	Dress Rehearsal and Exhibit Hours
	12/01/93 12:30 PM - 12/01/93 1:00PM	Demonstrsation Day 2, Exhibit Hours
	12/01/93 1:00 PM - 12/01/93 5:00 PM	Exhibit Hours
	12/01/93 5:00 PM - 12/01/93 6:00 PM	Free Play, Break
	12/01/93 6:00 PM - 12/01/93 8:00 PM	Exhibit Hours
	12/01/93 8:00 PM - 12/01/93 10:00 PM	Rehearsal for Day 3, Logging for Playback
	12/01/93 10:00 PM - 12/02/93 8:00 AM	Free Play, Break
Thursday Demo Day Number 3	12/02/93 8:00 AM - 12/02/93 10:00 AM	Dress Rehearsal for Day 3
	12/02/93 10:00 AM - 12/02/93 11:00 AM	Network Flooding Experiment, Exhibit Hours
	12/02/93 11:00 AM - 12/02/93 1:00 PM	Free Play, Exhibit Hours
	12/02/93 1:00 PM - 12/02/93 2:00 PM	Playback of Logged Demonstration
	12.02/93 2:00 PM - 12/02/93 3:00PM	Free Play
	12/02/93 3:00 PM	Network Teardown Begins

Network Traffic During Demonstration 1
Each point is a 10 second average or 1 second peak within that average.

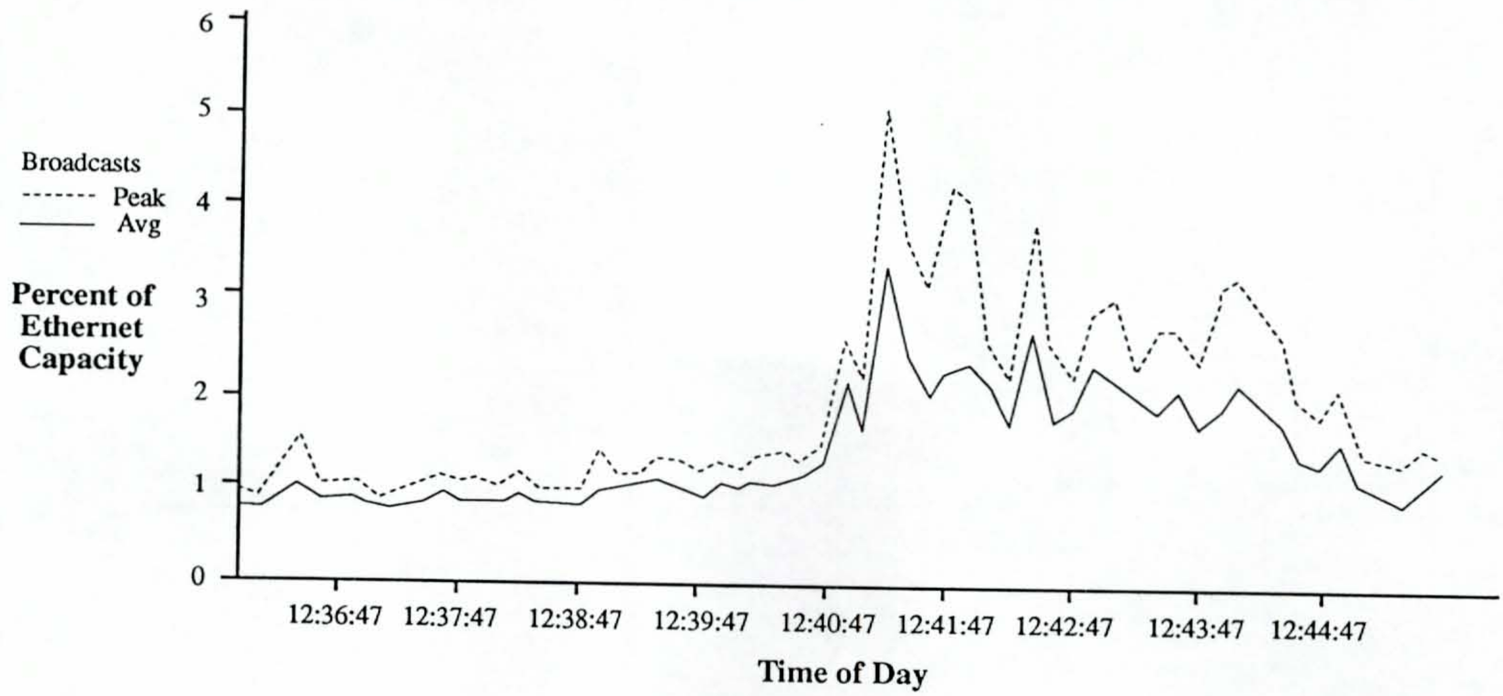


Figure 1

PDU Packet Traffic During Demonstration 1
Each point is a 10 second average or 1 second peak within that average.

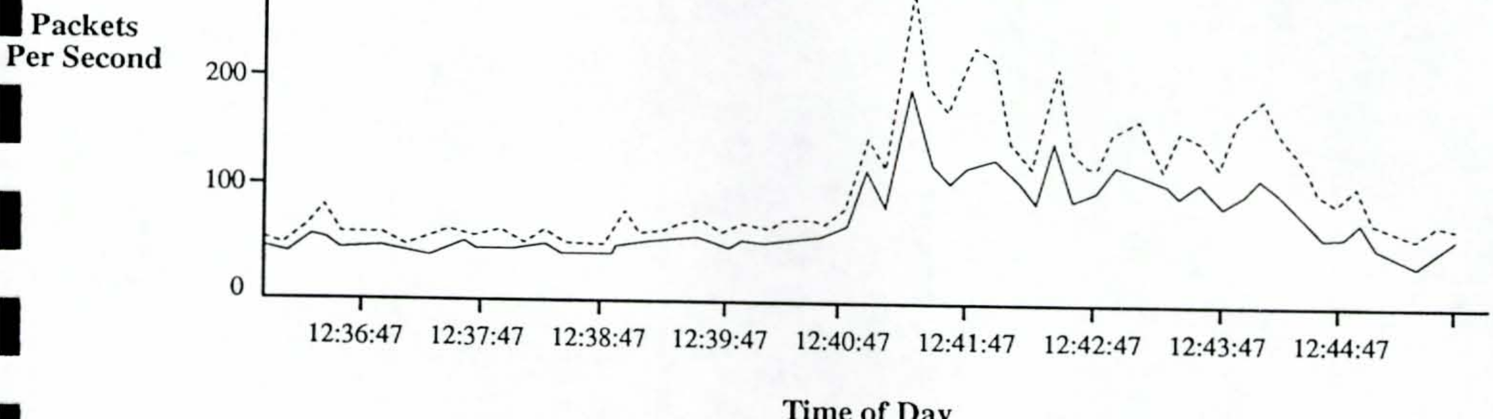


Figure 2

504-6288

Figure 3
DIS PDU Traffic, Days 1 & 2

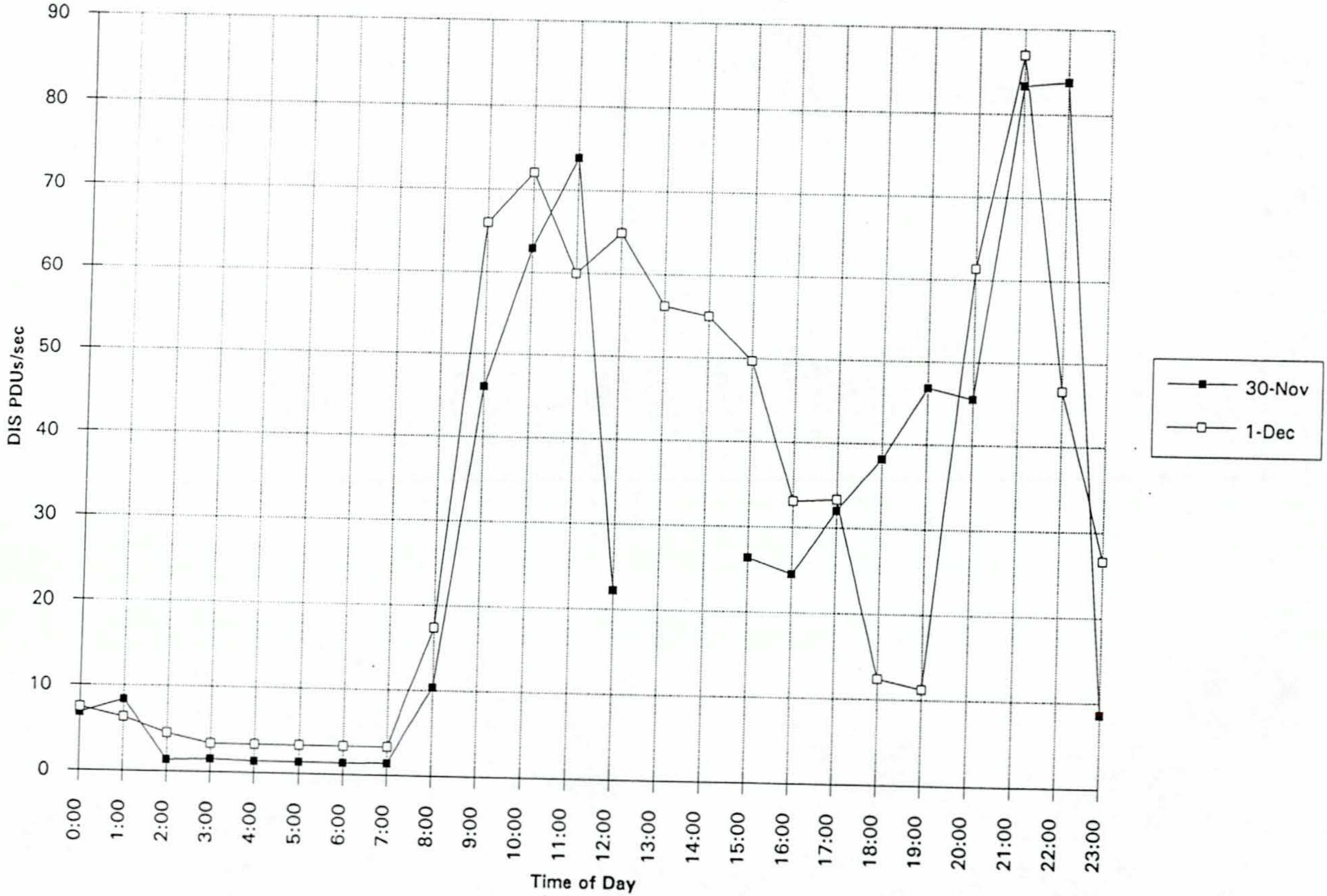
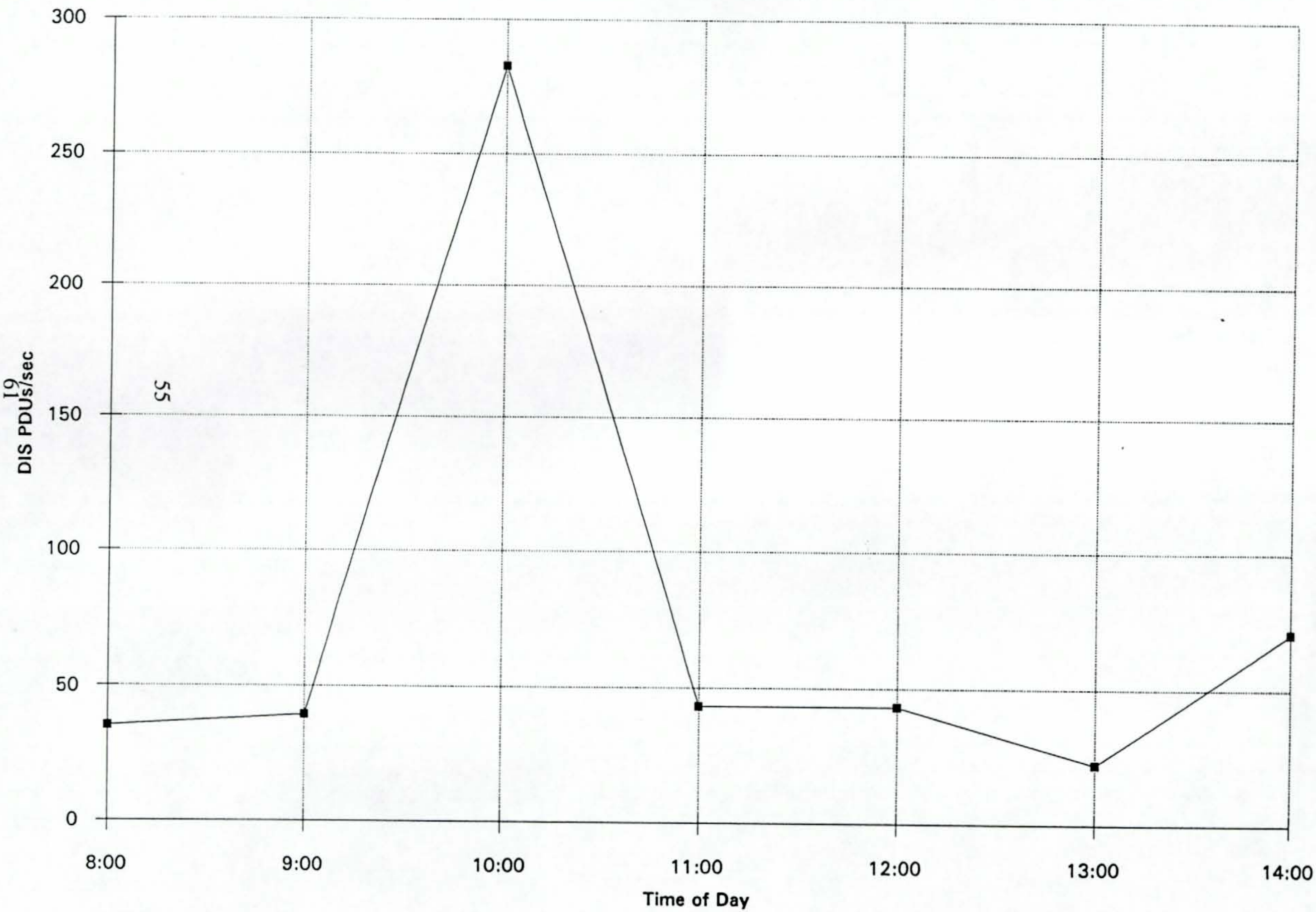


Figure 4
DIS PDU Traffic, Days 3



Appendix 7

Actions and Decisions

I/ITSEC DIS DEMONSTRATION
ACTIONS & DECISIONS
Update of 8/24

Actions:
( ) represents suspense date, * indicates new or updated entry

1. Project 2851 is to prepare and distribute upgraded Ft. Hunter-Liggett terrain data base to all participants (8/15). [distribution began 7/28]
2. Decide on PDU format for radio and emitters at the Apr. meeting.(completed 4/27) See decision #9 [radio defined 7/27, emitters to be decided at meeting 8/23]
3. Participants must decide on how many entities must be accommodated by the networked devices. IST has suggested 200. Decision will affect compliance testing. (6/15) See decision no. 15 to use 200.
4. DIS compliance test plan to be updated by Margaret Loper to reflect IEEE 1278 and distributed as well as put on the ADST bulletin board.(4/27) COMPLETED
5. Brian Goldiez to propose tests for visual correlation at next meeting.(4/27) Test methodology agreed to, results presented 6/15.(see action 27)
6. Goldiez to propose an approach for all to use in coordinate transformation for decision at the Apr. meeting. (4/27) (see follow up action no. 17)
7. STRICOM, Karen Williams, to determine how to make Govt. vehicles available to use in live demonstration at no cost to the company.(6/30)
8. IST, Smith, determine methodology to test participants ability to handle 200 entities on the net (5/15). Methodology to be implemented (See decision 15)
9*. IST, Williams, get volunteer(s) to provide "GOD'S eye view" for the demo. (4/27) (Several Prospects, to be confirmed by 7/29) [IDA will provide]
10. IST, Williams, get a knowledgeable, credible narrator for the demo.(8/1)
11. IST to find a facility to rehearse and stage the equipment prior to the demo. (4/27) COMPLETE, see 4/27 minutes on use of Marriott.
12. D. Shockley to look into possibility of using overhead wiring to set up the network this year to avoid cut wires. (4/27) COMPLETE overhead possible but probably not desirable.
13. IST to plan for provision of a DSI connection into the Marriott for the demo. (4/27) COMPLETED, DMSO is planning to fund and Houston Associates has it on their calendar to do an installation in November.

14. IST to get quotes on cost to have professional installation of the network this year. (6/15) (Still in process)
15. All who wish to participate this year are to complete their capabilities statements describing equipment and provide to IST by 31 May. The demo scenario will be built around the firms responding and others may be excluded. Test plans will be tailored to the capabilities. (5/31) (Suspense extended to 7/29)
16*. Hughes is to provide logged data containing the simulation management PDU so that IST can use is to insure other participants systems do not malfunction in its presence. (7/15) [Data provided]
17. Ken Oda will deliver coordinate conversion routines used by P2851 to IST, Williams for distribution to the other participants. Farid Mamaghani will provide TEC routines. A vote on routine to be used, IST proposed or other, will be taken next meeting. (6/15) (See action no. 28)
18. Any new models required by a participant must be developed by that organization but the 2851 Project office can get the model converted to SIF format and distributed using the resources of Kirtland AFB. (7/30)
19. DIS standards group need to get version 2.0.3 to the testbed team by 4/30 to avoid slip in test schedule. COMPLETE, but was late 2 weeks for radio & emitter.
20. Users of radio and emissions PDUs need to add information on this usage and applications to the capabilities statement before submitting. (5/30)
21. IST determine possibility of using video teleconference for future meetings (possibly using DSI nodes or AT&T). (5/30) COMPLETED, but IST does not see practical application at this time for 80+ person meeting.
22. IST will put out assigned numbers for IP addresses at next meeting. (6/15) Action deferred until a network is defined (15 Oct.)
23*. IST is to provide updated tables of entities and munitions at the next meeting. (6/15) Deferred until capability questionnaires are returned and need also to add info on radios and emitters.(7/29) [See action 44]
24. IST to find sources for projection equipment to use for the demo and see if firms will donate its use. (6/15) COMPLETE, IDA will handle the demonstration displays.
25. Margaret Loper will investigate further the use of IEEE 802.3 vs. ethernet and effects on repeaters/cable length limits etc. (6/15) COMPLETED, no reason to not use ethernet 2.0.
26. Margaret volunteered to re-run the Grumman program with up to 200 entities to show the throughput loads. (6/15) OPEN
27. Analysis of the Terrain Data Base correlation data by IST showed larger discrepancies than anticipated. The proposed 0.5 meter tolerance on differences between the visual database and the Project 2851 reference was

exceeded frequently and by large distances in some instances, leading to the need for further analysis by IST et. al. (Next report 7/29)
28. On the issue of coordinate conversion routines the question was raised as to how good are results, how does computational efficiency compare and what exists to validate the routines. Paul Birkel, MITRE, volunteered to research these issues and compare the P2851, IST and evolving DMA routines. (7/29) [see decision 19]
29*. IST (David Shen) is to distribute information on how to insure a "destruct" message is part of detonation PDUs. (7/29) [See decision 19]
30. Prospective participants need to contact the IST Testbed and schedule time for compliance testing of their device(s). Note that on average a test will consume one day and we are looking at about 50 entities. (ASAP)
31. Project 2851 representative is to provide an update brief on the new database and modified procedures for use at the next meeting since it is to be released shortly thereafter. (7/29)
32. IST (Amy Vanzant-Hodge) to get a UDP port number. (7/29) [Port # 6993 was selected]
33*. IST (Williams) to get a list of models currently available to support the demo. (7/29) [List done after meeting on 23 Aug., update being distributed with minutes of 8/24 meeting.]
34. Any new entities proposed for use this year must be indicated to IST by 15 Aug. if they are to have a chance of being included. (8/15)
35. Questionnaires distributed to Emissions players on 27 July must be returned to IST, Doug Wood, by 10 Aug. (8/10)
36. IST (Goldiez) and MITRE (Birkel) are to put coordinate conversion routines on the bulletin board before 23 Aug. (8/23)
37. Recommendations on TDB correlation criteria are to be provided to IST by 6 Aug. so that they can distribute the suggestions to all, prior to the next meeting. (8/6)
38. Any organization wanting to use its own or someone else's CGF representation for the demonstration needs to tell IST (Williams or Mullally) before 23 Aug. (8/23)
39. IST (Williams) is to explore getting easier access to the bulletin board by participants in demo planning/testing. (8/23)
40. Those who will provide models and those who process them need to meet to sort out details of how and who will take actions. Meeting will be held 23 Aug. at the Holiday Inn, Orlando. New models must be provided to Project 2851 by 1 Sep. (9/1)
41. In trying to reach resolution of the terrain correlation issue PRC Corp. was asked for two pieces of data. Identify the source of the "Z" values used as the standard in the correlation study and describe the algorithm used to convert terrain from SIMNET to DIS. (8/15)

42. Videos for IDA to use in preparing an "advertising" tape for the demo should be in Beta SP format if possible, 1" tape is second and VHS is least good. Tapes with Company scenes and Company logos, approximately 45 seconds long should be provided to IDA NLT 30 Sep. (9/30)
43. IST (Williams) to insure we can run separate experiment simultaneously on the ethernet during free play time. (9/13)
44. Attendees are to review the updated enumeration lists and report to IST if they find errors or omissions, recognizing several new entities have been created. (9/21)
45. Participants who wish to play via a long haul connection to the Marriott this year need to meet with the planners at 5:00 PM Thurs 16 Sep. at the Holiday Inn where the DIS Workshop is being held. (9/16)
46. Jim Williams is to check on cost and availability of a Conference Call set up at the Marriott for coordination of the demo participants. (9/14)
47. Participants are to provide J. Williams a sketch of their floorspace requirements, power demands, communications and anything else to support the checkout and rehearsal the week of the 22nd. Nov. This should be provided at the meeting on 14 Sep. (9/14)
48. There are still gaps in power needs for rehearsal week. Participants are to get requirementin to Keith Tanner ASAP.
49. All participants need to supply Jim Williams with a POC and day and night phone numbers for decision making or to resolve issues for NLT the beginning of rehearsal week. The POC will be responsible for decisions related to the demo during the I/ITSEC. (11/12)
50. Scott Smith made a new release of the testbed available on this date. There were problems in the release labeled "October 6". Scott Smith has a list of the specific items which have been fixed. New release will be provided by IST to Loral for posting on the ADST Bulletin Board NLT 10/21/93.
51. ARP tests have not yet been revised. Therefore, IST will test point to point and ARP as soon as the capability is available. Those systems which were not tested for point to point and ARP will be tested during rehearsal week.
52. Project 2851 update was given by Ken Oda. There were only minor problems noted to PRC (not identified to the group) with 2851 terrain. All problems have been resolved. PRC requested that new problems be tracked by a problem form provided to each recipient of P2851 data. Ken's presentation was given using view graphs. PRC is having problems putting contour lines on the maps. PRC will ship maps with contour lines NLT October 29 via FedEx.
53. There are several models which were not provided or cannot be accounted for by PRC. Software Systems will distribute the RAH-66, but

they have to get it from CAE-Link who have to get permission from the Army (Action is assigned to Sam Knight of Link). The biplane will not be generated. Regarding the black civilian car, PRC erred by not sending it out. PRC will send it out. The submarine periscope was provided to PRC and will be generated by PRC. Pioneer=UAV. Pioneer was not known to be a UAV by the modelers. PRC should have the DI as they were provided and used last year. (10/27)

54. IST (Ken Hardis via Scott Smith) and PRC will look for the SIF model of DI. (10/27)

55. IST will create a matrix of entity types vs SIF entity description. (10/27)

56. PRC will create a matrix of entity types vs. SIF directory name and location.

57. DEC will put network in place for IST. They will have a N/W monitor, smart hubs, and be able to pull nodes off of the network. Each participant registered for the I/ITSEC demonstration will get one thin net cable with a BNC connector. Multiple simulators for a participant will need to have bridge to route data to the simulator. Participants should identify exactly where in the booth the drop should occur (NLT than 10/29). Multiple networks will need to be in place during rehearsal week.

58. IST will develop a set of experiments which participants can sign up for. Distribution of experiments will be via e-mail.

59. DODDS will use the network. DODDS will be accomodated to the extent that they do not interfere with the DIS demo. Jim Williams will ensure scheduling does not interfere with network experiments.

60. Participants should provide space and power needs for rehearsal to either Jim Williams or Keith Tanner. Keith is the one who actually needs the information.

61. Participants should provide Jim Williams with a list of individuals who will be attending the rehearsal and need access to the rehearsal area. The list should be provided via e-mail or fax. Tanner will be providing security and only those who are badged or on the rehearsal list will be allowed access to the rehearsal hall.

62. The dimensions of models and a center of the bounding volume will be provided to IST by E&S. IST will distribute these quantities to other participants. This is a suboptimal solution as PRC is the origin of the data. PRC will investigate whether they can also provide this data. Articulated parts are excluded.

63. There were problems raised on using the IP address 255.255. The problem appeared to be peculiar to Suns. This matter cannot be resolved until the addressess are assigned. Every host will have an IP address. Host addresses also need to be assigned. IST will publish IP and host addresses

on e-mail. Participants will fax or e-mail IP address needs which are greater than 1 by the end of the week.
64. There will be a teleconference on 12 November at 1100 EST to discuss any testing problems or issues. IST will publish a phone number to call.

Decisions:
Dates in brackets indicate date of decision

1. Hold down cost of participation in the demo this year. Re-use the Ft. Hunter-Liggett terrain data base but get it upgraded in the 10x30 km. high resolution area. Goal for terrain matching is 1 meter in the high resolution area, best effort elsewhere. Culture matching not required at present but may need re-look. (3/23)
2. Decisions on conduct of the demo will be made by the participating organizations; one vote each. (3/23)
3. Put radios and emitters on the net this year. Determine the format of the PDUs at the Apr. meeting. (3/23)
4. A vote will be taken on coordinate conversion methodology at next meeting but all agreed precision requirement will be the floating point as specified in the IEEE standard. (4/27)
5. IST and 2851 PMO will test correlation of TDB. IST will provide 2000 coordinates and the visual vendors will provide their corresponding elevation data for evaluation by IST. Results will be compared to the 2851 value statistically. (4/27)
6. Will use the same FHL maps as used last year. (4/27)
7. All agreed that compliance testing must be completed prior to set up at the Marriott. A test cut-off date of 12 Nov. was adopted. The days of 22-25 Nov. are required to check out the network and rehearse the demonstration sequence. (4/27)
8. Participants need to commit by 1 Oct. to allow time for final network layout and script revisions. (4/27)
9. The demo will use the version 2.0.3 of the DIS standard. Entity State, Fire, Detonation, Collision (except for aircraft), Emissions(sonar, acoustic, radar, signal EW all mentioned), Transmitter, Signal, and Receiver will be in the demo while Laser and Aggregate/De-aggregate will be done as a side experiment. Several may employ Simulation Management so Hughes will provide IST logged data that can be used in testing to insure other participants systems don't bomb due to it. (4/27) [Decision of 7/27 meeting eliminated receiver]
10. Anyone needing a new model must get it created, themselves. Project 2851 can convert the model from multigen, or SIMNET to SIF format and

distribute. We will again use three levels of detail, no damage models and destroyed models turn black. (4/27)
11. Network will use UDP/IP on ethernet. FDDI will be considered for the interconnect between display rooms. (4/27)
12. Dead entities cannot reconstitute during a demo. (4/27)
13. Policy decisions for the demo include: No logistic PDUs, only 2 articulated parts on vehicles, use of both relative and absolute time stamps on the net allowed, use multiple exercise IDs, site and host IDs will be assigned by IST, dead reckoning algorithms 1, 3 & 8 will be used, use thresholds of 3 degrees and 1 meter but carry them as a parameter to allow fine tuning if required in rehearsal. (4/27)
14. Obsolete entry
15. The participants agreed that the IST testbed should stress test with 200 entities to insure that the SUT does not crash the network. (6/15)
16. Participants agreed that the datalogged information from the network does not constitute especially sensitive nor proprietary data and it should be made available to the participants ASAP after the event. (6/15)
17. Network for the demo will use ethernet 2.0 and broadcast DIS data. Non-DIS communication must be point to point. Like last year, ARP is recommended, not required. (6/15)
18. The demonstration participants will use broadcast on the ethernet, but will try to use multicast in experiment times outside the demo. (7/28)
19. For the purpose of the demo, bit 23 in the entity state appearance field will be used to indicate when an entity has been destroyed and needs to be removed from the simulation; such as when a missile should have impacted ground. A "1" in this space indicates that this is the last PDU the entity will transmit. (8/24)
20. Coordinate conversion algorithms will be a matter of Company choice, but participants are requested to tell IST what conversion routines they are using and for which applications. (8/24)
21. Terrain database correlation will be tested this year, using 2000 data points provided by project 2851. The test objective measure is 0.5 meters for ground vehicles, 16 meters for low flyers and 160 meters for high fixed wing aircraft. Players will not be allowed to interact with other entities closer to the ground than 6 times the mean {or mean plus Standard Deviation if it is larger} error measured in the test. If a land vehicle exceeds 0.5 meter mean error, the vehicle will be positioned in a fixed site for the demo. (8/24)
22. Participants agreed that if they fail to meet the criteria they will provide IST an analysis of what caused the errors so that this information can be included in the "lessons learned" for 93. (8/24)

23. Dead reckoning algorithms 1,2,3 & 4 were selected, by vote of the participants, to be used in the demo this year. [This is a change from an earlier decision.] (8/24)
24. There appears to still be unresolved matters as to when no additional models will be allowed. It appears that the list provided by IST on 6 October are still valid. The only open matter involves whether and how fragmentation will be handled. That is, it is not clear if additional models need to be created for fragmented models (Kaman). Kaman wants to track fragments of missiles after it intercepts a target as new entities. Kaman wants to track them as point masses and to explore if radar models pick up the fragments. Kaman has an entity structure available for review. Kaman would like visual images of the fragments. A maximum of 6 fragments will be allowed. The group allowed Kaman to proceed with their plan to model fragmentation with the provision that if there is any problem during rehearsal week, Kaman will withdraw their entity.
25. Three trucks will serve as a TOC.
26. We will decide on using Exercise ID and/or multiple networks with respect to how many experiments can run concurrently on the network(s). TheI/ITSEC group recommends that they be able to restrict network traffic for experimentation. We need to ensure that there are times for demonstration, experiments, and free play on the network. Demonstration times have controlled network access as allowed by the IITSEC participants. Experiments have controlled network access as allowed by the group in charge of the experiment time. Free play times anyone can be on the network. IST will develop apportionment of times subject to approval by the group during rehearsal week.
27. World coordinates and absolute velocity will be used for the initial and all velocities of munitions.
28. Listeners will be tested to ensure that they are not emitting and to ensure that if they die, that they do not corrupt the network.
29*. IST will not test terrain correlation for aircraft which do not use the Hunter Liggett terrain. We will restrict these (or any other entities which do not subject themselves to correlation tests) entities to an altitude of 2000 meters above mean sea level. Interaction rules will be modified to allow one way interaction with the ground. Air entities can engage other air targets in an air to air mode. Ground entities can fire at these air entities, but air entities cannot fire back.
30. An issue was surfaced to allow stealths to issue a PDU. A separate domain
would be created (Domain 9). Host ID would distinguish the stealth. Stealths could issue a PDU or use the current listener mode. If the stealth issues a PDU, it will be tested as any other entity. The matter was voted

down and stealths will not be allowed to issue PDUs for the demo. IST will create a full domain for observers (i.e., stealths which wish to issue ES PDUs).

31. V-22 model will not have an articulated part. It will be configured as an aircraft.

32.The network will be designed to handle no more than 200 entities.

34. Acoustic PDUs will be used, but will not be tested by IST. We need to ensure that these or any other non agreed upon PDUs do not disrupt other simulators.

Appendix 8

Breeze 1000 Testing Procedures Handbook

IST

BReeze™ 1000

TESTING

PROCEDURES

HANDBOOK

Institute for Simulation and Training
Orlando, Florida

October 17, 1993

BReeze™ 1000 TEST EQUIPMENT

Packing List

1.	BReeze™ 1000	(QTY 1)
2.	Power Cord for BReeze™ 1000	(QTY 1)
3.	Power Adapter for BReeze™ 1000	(QTY 1)
4.	15 FT. of Telephone Cable	(QTY 1)
5.	15 FT. of Thin Ethernet Cable	(QTY 1)
6.	T-Connector	(QTY 2)
7.	Terminator	(QTY 2)

Connecting the BReeze™ 1000 test system to your simulator.

1. Open shipping container and unpack all test equipment, being careful not to lose the T-connectors and terminators.

2. Decide where to place the test equipment. The test equipment must be placed within ***15 ft. of an ethernet connection*** to your simulator and ***15 ft. from an analog phone line*** to be used for dialing IST. You will also need a separate voice line for communication with IST during testing.

3. Plug the power adapter into the BReeze™ 1000 modem, and the standard power cord into the BReeze™ 1000 and then into the wall outlet.

4. Connect one end of the phone line to the slot marked ***line*** on the back of the BReeze™ 1000 and the other end must connect to the ***analog*** phone jack you have setup up for communicating with IST.

5. Connect the Thin wire ethernet cable to the *BNC* connector on the back of the BReeze 1000. Connect the other end of the ethernet cable into your network or simulator. Remember, you plug the center piece of the T-connector into your system under test. The ends of the cross bar of the T-connector are used to connect the computers together. **Be sure a terminator is placed on any open end of a T-connector.**

PROCEDURES FOR TESTING WITH THE BReeze™ 1000

The BReeze™ 1000 will be used as a bridge connecting two local area networks over the pubic switched telephone exchange (PBX) for communicating simulator nodes running Distributed Interactive Simulation (DIS) applications.

The way Breeze™ 1000 is designed to work when connected properly is as follows. When a packet arrives at the Breeze™ 1000, the Breeze™ 1000 checks the packet and determines where to send the packet. If the interface is a dynamic dialup interface (as in our case), the BReeze™ 1000 checks for an existing telephone link to the remote site. If a telephone link does not exist, the BReeze™ 1000 gets the telephone number for the interface from its dial-out record, and calls the remote Breeze™ 1000. When a modem connection is established, the sending Breeze 1000 encapsulates IP packets in a Point to Point Protocol (PPP) frames and sends them to the receiving Breeze 1000 over the telephone network.

In order for IST to perform DIS testing, you will be required to change your IP address to *132.170.191.95*, your broadcast IP address to *132.170.255.255,* and your *UDP port to 6993*, for IST to log your data and for the Breeze 1000 to function properly. Changing your broadcast IP address to *132.170.255.255* allows the Breeze 1000 to bridge all IP traffic on your network to IST in Orlando over the analog telephone line.

To begin testing you must have completed all previous steps outlined above. Establish a voice connection with IST to be sure IST personnel are ready to begin testing. Turn on your simulator and begin sending packets. Testing will proceed according to the predetermined specification process.

Appendix 9

Planning Scenarios

Day #1 - Tuesday, 30 November 1993

.1.01	Marconi	Submarine,TANGO Class	Sea, Subsurface

perate hostile OPFOR Submarine off the coast of Lilienthalia in the "UN NO SAIL ZONE." Launch cruise issile at U.S. Carrier Battle Group. "UN NO SAIL ZONE" includes any sea traffic in an area North of a oint extending 200 Kilometers due West from the Lilienthalia / Bartsylvania border located 10 Kilometers orth of Cape San Martin (387725) along the 83 grid line.

.1.02	Paramax Systems Corporation	SAF, CGF	Sea, SAF

reate a OPFOR CG 47 off the coast of Lilienthalia in the "UN NO SAIL ZONE." Launch a SAM missile at /A 18 aircraft and a Surface to Surface Missile at the Battle Group.

.1.03	NAWC / TSD (NTSC)	ship, carrier or frigate	Sea

perate one CV in offshore maneuver area. Launch and receive V-22 aircraft. Fire Sea Sparrow at ncoming OPFOR Aircraft.

.1.04	Coleman Research Corp.	CG-47	Sea, Air

perate one CG-47 off the coast of Bartsylvania. Sail in formation with CV. Launch AA Missile against PFOR intruder Aircraft to protect CV.

.1.05	FAAC-TRW	Surrogate Missile	Sea, Air Defense

rovide AD for the TRW Aegis Cruiser. Model emissions system (search radar for the ship and can/acquisition, track and track/illumination for the fire control system) and engage multiple threats with Standard missile model. FAAC will fire SM 2 Missile(s) at one or more incoming hostile aircraft or nti-ship missiles.

.1.06	TRW, Systems Integration Group	Aegis Cruiser	Sea, Air Defense

RW will supply an AEGIS Cruiser and operate with the Carrier Battle Group. FAAC simulates the AEGIS ruiser emission system and engages incoming threats (TBD) with a Standard Missile Model or with a vith a Sea Sparrow Missile Model. Provides AD for the TRW Aegis Cruiser.

.1.07	NSWC /Port Hueneme Div.	BFTT	Sea

Operate one Ship (FFG) in offshore maneuver area off the coast of Bartsylvania. Sail in formation with RW Aegis Cruiser (CG-47) and NAWC TSD CV. Engage incoming air or subsurface threats (Air or Missile TBD) with a Standard Missile (SM1). Launch ASROC if available at OPFOR Sub. Provide AD for he CV.

.1.08	Raytheon Company, MSD	Tomahawk Missile	Sea, Air

Operate TLAM from US Ship at Sea (BFTT FFG-12) against SILKWORM target located ashore in Lilienthalia (Coordinates 265927).

1.1.09	Digital Equipment Corporation	F/A 18	Air

Operate 1 F/A-18 in support of Advanced Force of the Surface Battle Group. Fly in 3Plane formation with NAWC/ TSD and Northrup ATDC Engage OPFOR aircraft in "UN NO SAIL ZONE".

1.1.10	Northrop Advanced Technology	F/A 18	U. S. Air, F/A 18,

Operate 1 F/A-18 in support of Advanced Force of the Surface Battle Group. Fly in 3 Plane formation with NAWC/ TSD and DEC. Engage OPFOR aircraft in "UN NO SAIL ZONE".

1.1.11	NAWC / TSD (NTSC)	F/A 18	Sea, Air, F/A 18

Operate 1 F/A-18 in support of Advanced Force of the Surface Battle Group. Fly in 3 Plane formation with NORTHRUP ATDC and DEC. Engage OPFOR aircraft in "UN NO SAIL ZONE".

1.1.12	VEDA, Inc.	E-2C	Air

Operate E-2C from the CV and provide an EW radar platform for the Battle Group. Fly racetrack course 30 k. North to South parallel to coastline. (Position TBD)

1.1.13	NAWC/AC, Manned Flight	AH IW	Sea, Air, AH1W

Operate 1 AH-1W in the objective area. Provide CIFS and act as a FAC(A) to call air support for the British TF CHURCHILL or U. S. Ground Forces on the border. Fire Guns, 2.75" Rockets and TOW missiles as required.

1.1.14	NAWC/AD, Manned Flight	V-22	Sea, Air, V-22

Operate 1 V-22 from CV deck. (Icon modelled for vertical flight only.) Simulate vertical lift-off from CV and fly inland to airstrip and simulate the landing of supplies and troops and the evacuation of wounded.

1.1.15	Lockheed, Ft Worth Company	CGF	SAF

Operate 2 MIG-29s in "UN NO FLY ZONE". Engage ships in U.S. Battle Group with air-to-surface missiles. Engage F/A-18s with air-to-air missiles in "UN NO FLY ZONE".

Day #1 - Tuesday, 30 November 1993

1.2.01	MARCONI Simulation	Warrior ACV,	UK Ground, Warrior AFV

TF CHURCHILL (TF CHURCHILL = DOAC, APRE, DRA and Marconi) will consist of 2 Challenger Tanks and 2 Warrior AFVs reinforced with an Avenger (Boeing). Marconi Warrior will fire a TOW missile at ground or helo threats. TF CHURCHILL will be located in the vicinity of the Western Border crossing (Coord. 5982). They will repel an OPFOR attack across the border at 602837 or at 608829 depending on the suitability of the terrain. LORAL ADS SAF Will provide 2 HIND MI-24 Helos and 2 BMPs to assault the border point.

1.2.02	Defense Research Agency	Warrior/ Challenger	UK, Ground

Participate in TF CHURCHILL. TF CHURCHILL (TF CHURCHILL = DOAC, APRE, DRA and Marconi) will consist of 2 Challenger Tanks and 2 Warrior AFVs reinforced with an Avenger (Boeing). TF CHURCHILL will be located in the vicinity of the Western Border crossing (Coord. 5982). They will repel an OPFOR attack across the border at 602837 or at 608829 depending on the suitability of the terrain. LORAL ADS SAF Will provide 2 HIND MI-24 Helos and 2 BMPs to assault the border point.

1.2.03	Defense Operations Analysis	SAF	UK Ground

Participate in TF CHURCHILL. TF CHURCHILL (TF CHURCHILL = DOAC, APRE, DRA and Marconi) will consist of 2 Challenger Tanks and 2 Warrior AFVs reinforced with an Avenger (Boeing). TF CHURCHILL will be located in the vicinity of the Western Border crossing (Coord. 5982). They will repel an OPFOR attack across the border at 602837 or at 608829 depending on the suitability of the terrain. LORAL ADS SAF Will provide 2 HIND MI-24 Helos and 2 BMPs to assault the border point.

1.2.04	Loral- ADS	ModSAF	SAF

LORAL ADS SAF Will provide 2 HIND MI-24 Helos and 2 BMPs to assault the border point in Scenario #1. They will create an OPFOR attack across the border at 602837 or at 608829 depending on the suitability of the terrain.

1.2.05	Boeing Space and Defence	1 Avenger	Ground (Air Defense)

Boeing will provide AD Support (Avenger) for British contingient. Boeing will locate the Avenger in the vic. of the high ground overlooking the Border at 575823. Boeing will fire on the 2 LORAL ADS SAF HIND MI-24 Helos assaulting the border point. TF CHURCHILL will be located in the vicinity of the Western Border crossing (Coord. 5982). They will repel an OPFOR attack across the border at 602837 or at 608829 depending on the suitability of the terrain.

1.2.06	CAE-Link	RAH-66 Commanche	Air, U.K. Ground

The CAE-Link RAH-66 "Commanche" helo will provide CIFS support for the British contingient. TF CHURCHILL will be located in the vicinity of the Western Border crossing (Coord. 5982). They will repel an OPFOR attack across the border at 602837 or at 608829 depending on the suitability of the terrain. LORAL ADS SAF Will provide 2 HIND MI-24 Helos and 2 BMPs to assault the border point.

Day #1 - Tuesday, 30 November 1993

1.3.01	SAIC	SAF	U. S. Ground

SAIC SAF will drive the civilian cars and Busses in the Non-Combatant Evacuation Convoy containing the U.S. Ambassador to Lilienthalia. The convoy consisting of 5 sedans, 6 buses, and 4 covered 6x6 Army Trucks will be initially created in the vic of coord. 785845. The convoy may be moving or stopped due to road blocks depending on the situation.

1.3.02	Hughes Training	NLOS	U. S. Ground

Operate NLOS in Bartsylvania with U.S. Armored TF PEACEMAKER near border crossings in the vicinity of 645815 or 639811. Engage OPFOR Tanks and AFVs with NLOS from overwatch positions. Cooperate with LOSAT provided by TI and M1 Tanks from IBM, Martin Marietta and VP Tank from TACOM and SAFDI from Raytheon.

1.3.03	Texas Instruments	M2 BFV	U.S. Ground, M2 BFV

Operate 1 M2 BFV in Bartsylvania near Eastern border crossing point with U.S. Armored TF PEACEMAKER near border crossings in the vicinity of 645815 or 639811. Organize Tank Platoon (reinf) with IBM, Martin Marietta and TACOM. Cooperate with NLOS provided by Hughes Training and SAFDI provided by Raytheon. Engage OPFOR Tanks and AFVs from overwatch positions.

1.3.04	U. S. Army Tank Automotive	VP Tank	U. S. Ground

Operate 1 VP Tank in Bartsylvania with U.S. Armored TF PEACEMAKER near Eastern border crossings in the vicinity of 645815 or 639811. Organize Tank Platoon (reinf) with IBM, Martin Marietta and NLOS provided by Hughes Training and SAFDI provided by Raytheon. Engage OPFOR Tanks and AFVs from overwatch positions.

1.3.05	Raytheon, Equipment Division	SAF DI	U.S. Ground SAF

Operate (IST developed) SAFDI in Bartsylvania with U.S. Armored TF PEACEMAKER near Eastern border crossings in the vicinity of 645815 or 639811. Provide OPFOR DI for border incursion. Provide DI firing dragon from border defensive positions at OPFOR vehicles.

1.3.06	McDonnell Douglas Training	UH-60	U.S. Air, Helo, UH-60

Operate DF receiver onboard UH-60. Cooperate with UAV (Veda and Hughes) and AH-1W (NAWC). Provide DF information and vector to network players. MED EVAC SAFDI casualities if required.

1.3.07	Martin Marietta	M1A2	U.S. Ground, M1A2

Operate 1 M1A2 Tank in Bartsylvania with U.S. Armored TF PEACEMAKER near Eastern border crossings in the vicinity of 645815 or 639811. Organize Tank Platoon (reinf) with IBM and TACOM. Cooperate with NLOS provided by Hughes Training and LOSAT provided by TI and SAFDI from Raytheon.

1.3.08	Loral- ADS	ModSAF	SAF

LORAL ADS SAF Will provide 2 T-72s and 2 BMPs to assault the border point in Scenario #1. They will create an OPFOR attack across the border near Eastern border crossings points in the vicinity of 645815 or 639811, depending on the suitability of the terrain.

1.3.09	IBM (FSC) CCTT IDT	M-1A2 Tank	Ground

Operate 1 M1A1 Tank in Bartsylvania with U.S. Armored TF PEACEMAKER near Eastern border crossings in the vicinity of 645815 or 639811. Organize Tank Platoon (reinf) with Martin Marietta and TACOM. Cooperate with NLOS provided by Hughes Training and LOSAT provided by TI and SAFDI from Raytheon.

1.3.10	Reflectone, Inc.	3 AH 64s 1 OH-58	Air

Operate 3 AH 64s and 1 OH58 to provide support to ground forces as required in border incursion by OPFOR units. Engage Tanks and BMPs with Cannon, Rockets, and HELLFIRE Missiles in Eastern zone in support of U. S. Armored TF PEACEMAKER near Eastern border crossings in the vicinity of 645815 or 639811.

1.3.11	ESL Inc.	DF System	Air (STEALTH,

Operate DF receiver onboard UH-60 (McDonnel Douglas) and UAVs (Veda and Hughes) and AH-1W (NAWC). Provide DF information and vector to network players on location of Ambassador with convoy.

1.3.12	Hughes Training	UAV (Team with ESL (Robert	Air

Operate UAV and provide a platform for a DF receivers onboard UH-60 (McDonnel Douglas) and UAVs (Veda and Hughes) and AH-1W (NAWC). Provide DF information and vector to network players. Fly racetrack course 15 k. long, East to West 1 K South and parallel to border from gridline 65 West (JOLON).

1.3.13	Technology Systems Inc	VOICE INTERCOM	Emissions (Voice

Operate Voice Intercom between units involved in DFing RF emissions. Provide radio to Ambassador with convoy.

Day #1 - Tuesday, 30 November 1993

.4.01	Lockheed Sanders	Patriot	Air Defense, Ground

perate Patriot Missile firing battery in Bartsylvania in the vicinity of 545785. Provide AD coverage within one as required against OPFOR SCUD and aircraft threats.

.4.02	Lockheed Missiles & Space	SCUD TEL., Radar, Scud Missile,	Air Defense

perate SCUD Missile firing battery in Lilienthaliaia in the vicinity of 7799. Fire (2)SCUDs. Create SCUD aunch sites and disperse site in real time. One firing will be as target for Patriot and one firing as target or THAAD. (NOTE: LMSC will create a FEWS satelite (Non-visual, No PDUs) for use in the THAAD play. MSC will shoot the THAAD. Lockheed Sanders will fire one Patriot.) Operate THAAD Missile firing attery in Bartsylvania. Fire THAAD. Create THAAD Launch sites and disperse site in real time.

.4.03	General Research Corporation	Threat Missile	Air Defense

perate Threat Missile firing battery in Lilienthalia in the vicinity of 265925. Provide AD coverage within one as required against U. S. aircraft threats.

.4.04	Coleman Research Corp.	SAM Missile	Air Defense, Air

rovide one SCUD Missile Launch from Lilienthalia vic 5495. Also provide a Patriot battery in artsylvania which tracks and sucessfully engages (intercepts) the threat missile. In addition, provide ne SCUD launch which poses no threat to Bartsylvania. After this SCUD comes into radar track, the Booz llen TOC will alert the CRC Patriot launcher/TOC to disengage the threat (i.e. no interceptor will be fired gainst this threat). This SCUD will impact at an uninhabited, specified location.

.4.05	McDonnell Douglas Training	F-15E	U.S. Air, F-15

perate an F-15E in an anti-air and Anti-SCUD role in the Objective Area. Cooperate with X-31 and C-130 possible.

.4.06	Kaman Sciences Corp.	Missile	Air

perate Missile Frag model in cooperation with Patriot and Scud Missile Launchers to provide a Missile eakup Fragmentation Model.

.4.07	Rockwell Space Division	X-31	Air

perate 1 X-31 in support of anti-air operations in Lilienthalia. Operate with F-15 in SCUD Search.

.4.08	Hughes Training Inc.	JSTARS Aircraft	Air

perate JSTARS Aircraft in Bartsylvania. Fly racetrack course 30 k. North to South parallel to coastline. osition TBD)

.4.09	Booz. Allen & Hamilton, Inc.	Plan View	Non-Emitter (Plan View)

ovide an Air Defense Battalion Tactical Operations Center (TOC) to be used in conjunction with the leman Research simulations. BAH will transmit a TOC entity state PDUs and radio communication DUs. In scenario #1 the BAH TOC will receive a radio communication message from the Coleman esearch simulation to track air threat entities. The BAH TOC will determine the threat TBM will not pact in an area of concern so a disengage message will be sent to the Coleman Simulation. Creating tity state for 3 trucks. Will send RF communications on the net.

Day #1 - Tuesday, 30 November 1993

1.5.01	Lockheed Aeronautical Systems	C-130	Air
Operate a C-130 in the Bartsylvania area. Demonstrate take off and landings from expeditionary airfield (Coordinates TBP). C-130 equipped with active emmitters conducts surveillance missions over Lilienthalia.			
1.5.02	Lockheed, Ft Worth Company	CGF	SAF
Operate 2 MIG-29s in "UN NO FLY ZONE". Engage F-16s over Lilienthalia. Operate CGF as required to generate SAM sites, Radars etc. as required.			
1.5.03	Armstrong Laboratory	2 ea F-16s	Air
The 2 AL/HRA F-16s will provide air support as required in this Scenario. The F-16s will be able to engage other aircraft with air-to-air missiles.			
1.5.04	Lockheed, Ft Worth Company	1 F-16C	Air
Operate 1 F-16 in CAP mission into "UN NO FLY ZONE". Fly in 2 Plane formation with Motorola Computer Group / NTSC. Engage MIG-29s over Lilienthalia. Can Drop Mk82 bombs and HARMS and Maverick missiles.			
1.5.05	Lockheed, Ft Worth Company	1 F-16	Air
Operate 1 F-16 in CAP mission into "UN NO FLY ZONE". Fly in 2 Plane formation with AFHRL. Engage MIG-29s over Lilienthalia. Air-to-Air Only.			
1.5.06	Lockheed, Ft Worth Company	1 F-16	Air
Operate 1 F-16 in CAP mission into "UN NO FLY ZONE". Fly in 2 Plane formation with AFHRL. Engage MIG-29s over Lilienthalia.			
1.5.07	Encore Computers	MIG-29	Air
Operate 1 MIG-29 in "UN NO SAIL ZONE". Fly in 2 Plane formation with Motorola Computer Group / NTSC. Engage US aircraft in "UN NO SAIL ZONE".			
1.5.08	Motorola Computer Group /	Mig-29	Air
Operate 1 MIG-29 in "UN NO FLY ZONE". Fly in 2 Plane formation with Encore Computers. Engage US aircraft in "UN NO FLY ZONE".			

Day #1 - Tuesday, 30 November 1993

.6.01	Lockheed Sanders	DIS Listener	Air Defense, Ground
O PDUs on Net, Listen only. No Scenario Play.			
6.02	Sogitec Industries	MESA (French Air Defense System)	Non-Emitter, Air
NO PDUs on Net, Listen only. No Scenario Play.			
6.03	IDA	STEALTH	Non-Emitter,(STEALTH)
NO PDUs on Net, Listen only.			
6.04	Raytheon Company, MSD	DIS Listener	Non-Emitter, DIS
O PDUs on Net, Listen only. No Scenario Play.			
.6.05	TRW, MEAD	Plan View	Plan View
O PDUs on Net, Listen only. No Scenario Play.			
.6.06	Armstrong Laboratory	Gci station	Non-Emitter (Simulated
O PDUs on Net, Listen only. No Scenario Play.The AL/HRA Gci station will provide information on air tercepts to all networked USAF players. The GCI is not an Emitter.			
.6.07	Technology Systems, Inc.	DIS Listener	Non-Emitter, (STEALTH)
O PDUs on Net, Listen only. No Scenario Play.			
.6.08	NAWC / TSD (NTSC)	STEALTH	Non-Emitter (STEALTH)
NO PDUs on Net, Listen only. No Scenario Play.			
6.09	ARPA (SAIC) WARBREAKER	STEALTH	Non-Emitter (STEALTH)
No PDUs on the net.			
6.10	Armstrong Laboratory	Data Logger	Non-Emitter (Data
DATA Logger only. No PDUs on the net.			
6.11	McDonnell Douglas Training	DIS Listener	Non-Emitter, (Plan
O PDUs on Net, Listen only. No Scenario Play.			
.6.12	McDonnell Douglas Training	DIS Listener	Non-Emitter (Network
O PDUs on Net, Listen only. No Scenario Play.			
.6.13	Mitre	DIS Listener	Non-Emitter (DIS
O PDUs on Net, Listen only. No Scenario Play.			
6.14	Digital Equipment Corporation	STEALTH/ Plan View	Non-Emitter (STEALTH)
NO PDUs on Net, Listen only. No Scenario Play.			
6.15	McDonnell Douglas Training	Data Logger, Board Level Motorola	Non-Emitter (Data
NO PDUs on Net, Listen only. No Scenario Play.			
6.16	Army Personnel Research	CGF/PLAN VIEW/STEALTH	Non-Emitter (STEALTH)
O PDUs on Net, Listen only. No Scenario Play.			
.6.17	Concurrent Computer	Stealth , Data Logger, Monitor	Non-Emitter (Stealth ,
PDUs on the net.			
.6.18	Silicon Graphics Inc.	STEALTH	Non-Emitter, (STEALTH)
PDUs on the net.			
.6.19	Lockheed Sanders	DIS Listener	CGF
O PDUs on Net, Listen only. No Scenario Play.			
6.20	Lockheed Sanders	DIS Listener	Ground
IO PDUs on Net, Listen only. No Scenario Play.			
6.21	Loral-ADS	Stealth	Non-Emitter (STEALTH)
O PDUs on Net, Listen only. No Scenario Play. (No Air-to-Ground)			
6.22	Loral-ADS	Stealth	Non-Emitter (STEALTH)
O PDUs on Net, Listen only. No Scenario Play. (No Air-to-Ground)			

Day #2 - Wednesday, 1 December 1993

2.1.01	Marconi	Submarine,TANGO Class	Sea, Subsurface
Operate hostile OPFOR Submarine off the coast of Lilienthalia in the "UN NO SAIL ZONE." Launch cruise missile at U.S. Forces ashore. "UN NO SAIL ZONE" includes any sea traffic in an area North of a point extending 200 Kilometers due West from the Lilienthalia / Bartsylvania border located 10 Kilometers North of Cape San Martin (387725) along the 83 grid line.			
2.1.02	Paramax Systems Corporation	SAF, CGF	Sea, SAF
Create a OPFOR CG 47. Launch Surface to Surface missile at U.S. Ship target (CV).			
2.1.03	NAWC / TSD (NTSC)	ship, carrier or frigate	Sea
Operate one CV in offshore maneuver area. Land and launch UH-60.			
2.1.04	Coleman Research Corp.	CG-47	Sea, Air
Provide 2 plane Mig-29 Raid Launched from Lilienthalia against Carrier Battle Group. Arm Migs with ASM Missiles.			
2.1.05	FAAC-TRW	Surrogate Missile	Sea, Air Defense
Provide AD for the TRW Aegis Cruiser. Model emissions system (search radar for the ship and scan/acquisition, track and track/illumination for the fire control system) and engage multiple threats with a Standard missile model. FAAC will fire Sea Sparrow Missile(s) or Ship launched missile(s) at one or more incoming hostile aircraft, at one or more incoming air launched missile(s) (ASM), one or more incoming ground launched missile(s)(SSM), or at one or more incoming ship launched missile(s) (SSM).			
2.1.06	TRW, Systems Integration Group	Aegis Cruiser	Sea, Air Defense
TRW will supply an AEGIS Cruiser and operate with the Carrier Battle Group. FAAC simulates the AEGIS Cruiser emission system and engages incoming threats (TBD) with a Standard Missile Model or with a with a Sea Sparrow Missile Model. Provides AD for the TRW Aegis Cruiser.			
2.1.07	NSWC /Port Hueneme Div.	BFTT	Sea
Operate one Ship (FFG-12) in offshore maneuver area off the coast of Bartsylvania. Sail in formation with TRW Aegis Cruiser (CG-47) and NAWC TSD CV. Simulate the FFG emission system and engages incoming threats (TBD) with a Standard Missile Model. Provides AD for the CV.			
2.1.08	Raytheon Company, MSD	Tomahawk Missile	Sea, Air
Operate TLAM from US Ship at Sea (BFTT FFG-12) against targets (SCUD Site,Coordinates TBD) located ashore in Lilienthalia.			
2.1.09	Digital Equipment Corporation	F/A 18	Air
Operate 1 F/A-18 in CAS mission to escort V-22s into Bartsylvania. Fly in 2 Plane formation with Cambridge Research Associates. Divert to provide CAS to British "TF CHURCHILL" on border.			
2.1.10	Northrop Advanced Technology	F/A 18	U. S. Air, F/A 18,
Operate 1 F/A-18 as CAS in support of ground operations. Fly in 2 Plane formation with NAWC/ TSD. Engage OPFOR armor in border attacks.			
2.1.11	NAWC / TSD (NTSC)	F/A 18	Sea, Air, F/A 18
Scenario #2 - Operate 1 F/A-18 as CAS in support of ground operations. Fly in 2 Plane formation with NORTHRUP ATDC. Provide top cover for Northrup. Engage OPFOR air as required in border attacks.			
2.1.12	VEDA, Inc.	E-2C	Air
Operate UAV and provide a platform for a DF receivers onboard UH-60 (McDonnel Douglas) and UAVs (Veda and Hughes) and AH-1W (NAWC). Provide DF information and vector to network players. Fly racetrack course 15 k. long, East to West 1 K South and parallel to border from gridline 65 East (JOLON).			
2.1.13	NAWC/AC, Manned Flight	AH IW	Sea, Air, AH1W
Operate 1 AH1W in the objective area. Provide CIFS and act as escort for V-22s. Provide CIFS and act as a FAC(A) to call air support for the British TF CHURCHILL or U. S. Ground Forces on the border. Engage with Guns, 2.75" Rockets and TOW missiles as required.			
2.1.14	NAWC/AD, Manned Flight	V-22	Sea, Air, V-22
Operate V-22 in the objective area. Provide simulated airlift support for the border units in contact.			
2.1.15	Lockheed, Ft Worth Company	CGF	SAF
Operate 2 MIG-29s in "UN NO FLY ZONE". Engage ships in U.S. Battle Group with air-to-surface missiles. Engage F/A-18s with air-to-air missiles in "UN NO FLY ZONE".			

Day #2 - Wednesday, 1 December 1993

.2.01	MARCONI Simulation	Warrior ACV,	UK Ground, Warrior AFV

F CHURCHILL will consist of 2 Challenger Tanks and 2 Warrior AFVs reinforced with an Avenger. (TF HURCHILL = DOAC, APRE, DRA and Marconi). Marconi Warrior has a TOW missile. TF CHURCHILL will e located in the vicinity of the Western Border crossing (Coord. 5982). They will repel an OPFOR attack cross the border at 602837 or at 608829 depending on the suitability of the terrain. LORAL ADS SAF Will ovide 2 HIND MI-24 Helos, 2 T-72 Tanks and 4 BMPs to assault the border point.

.2.02	Defense Research Agency	Warrior/ Challenger	UK, Ground

articipate in TF CHURCHILL. TF CHURCHILL (TF CHURCHILL = DOAC, APRE, DRA and Marconi) will nsist of 2 Challenger Tanks and 2 Warrior AFVs reinforced with an Avenger (Boeing). TF CHURCHILL ll be located in the vicinity of the Western Border crossing (Coord. 5982). They will repel an OPFOR ttack across the border at 602837 or at 608829 depending on the suitability of the terrain. LORAL ADS AF Will provide 2 HIND MI-24 Helos, 2 T-72 Tanks and 4 BMPs to assault the border point.

2.03	Defense Operations Analysis	SAF	UK Ground

F CHURCHILL will consist of 2 Challenger Tanks and 4 Warrior AFVs reinforced with an Avenger. (TF HURCHILL = DOAC, APRE, DRA and Marconi). Due to the Long Haul Network involved TF CHURCHILL l be committed to support of Lilienthalia/Bartsylvanian Border Crossing Point from a fixed position in three scenarios. They will repel an OPFOR attack across the border at 602837 or at 608829 depending n the suitability of the terrain. LORAL ADS SAF Will provide 2 HIND MI-24 Helos, 2 T-72 Tanks and 4 IPs to assault the border point.

.2.04	Loral- ADS	ModSAF	UK Ground, SAF

ORAL ADS SAF Will provide 2 HIND MI-24 Helos, 2 T-72 Tanks and 4 BMPs to assault the border point. ey will create an OPFOR attack across the border at 602837 or at 608829 depending on the suitability of terrain.

.2.05	Boeing Space and Defence	1 Avenger	Ground (Air Defense)

eing will provide AD Support (Avenger) for British contingient. Boeing will locate the Avenger in the vic. the high ground overlooking the Border at 575823. Boeing will fire on the 2 LORAL ADS SAF HIND I-24 Helos assaulting the border point. LORAL ADS SAF Will provide 2 HIND MI-24 Helos, 2 T-72 nks and 4 BMPs to assault the border point. They will create an OPFOR attack across the border at 2837 or at 608829 depending on the suitability of the terrain.

.2.06	CAE-Link	RAH-66 Commanche	Air, U.K. Ground

e CAE-Link RAH-66 "Commanche" helo will provide CIFS support for the British contingient. TF URCHILL will be located in the vicinity of the Western Border crossing (Coord. 5982). They will repel an PFOR attack across the border at 602837 or at 608829 depending on the suitability of the terrain. LORAL DS SAF Will provide 2 HIND MI-24 Helos, 2 T-72 Tanks and 4 BMPs to assault the border point.

Day #2 - Wednesday, 1 December 1993

2.3.01	SAIC	SAF	U. S. Ground

SAIC SAF will drive the civilian cars and Busses in the Non-Combatant Evacuation Convoy containing the U.S. Ambassador to Lilienthalia. The convoy consisting of 5 sedans, 6 buses, and 4 covered 6x6 Army Trucks will be initially created in the vic of coord. 785845. The convoy may be moving or stopped due to road blocks depending on the situation.

2.3.02	Hughes Training	NLOS	U. S. Ground

Operate NLOS in Bartsylvania with U.S. Armored TF PEACEMAKER near border crossings in the vicinity of 645815 or 639811. Engage OPFOR Tanks and AFVs with NLOS from overwatch positions. Cooperate with LOSAT provided by TI and M1 Tanks from IBM, Martin Marietta and VP Tank from TACOM and SAFDI from Raytheon.

2.3.03	Texas Instruments	M2 BFV	U.S. Ground, M2 BFV

Operate 1 M2 BFV in Bartsylvania near Eastern border crossing point with U.S. Armored TF PEACEMAKER near border crossings in the vicinity of 645815 or 639811. Organize Tank Platoon (reinf) with IBM, Martin Marietta and TACOM. Cooperate with NLOS provided by Hughes Training and SAFDI provided by Raytheon. Engage OPFOR Tanks and AFVs from overwatch positions.

2.3.04	U. S. Army Tank Automotive	VP Tank	U. S. Ground

Operate 1 VP Tank in Bartsylvania with U.S. Armored TF PEACEMAKER near Eastern border crossings in the vicinity of 645815 or 639811. Organize Tank Platoon (reinf) with IBM, Martin Marietta and NLOS provided by Hughes Training and SAFDI provided by Raytheon. Engage OPFOR Tanks and AFVs from overwatch positions.

2.3.05	Raytheon, Equipment Division	SAF DI	U.S. Ground SAF

Operate SAFDI (IST developed) to provide ground forces as required with U.S. Armored TF PEACEMAKER near Eastern border crossings in the vicinity of 645815 or 639811. Provide OPFOR DI for border incursion. Provide DI for troops dismounting from C-130s and V-22s in the objective area. Provide DI for FM radio for DFing.

2.3.06	McDonnell Douglas Training	UH-60	U.S. Air, Helo, UH-60

Scenario #2 - Operate DF receiver onboard UH-60. Cooperate with UAV (Veda and Hughes) and AH-1W (NAWC). Provide DF information and vector to network players. Simulate airstrip landings and takeoffs if possible of MED EVAC SAFDI casualities.

2.3.07	Martin Marietta	M1A2	U.S. Ground, M1A2

Operate 1 M1A2 Tank in Bartsylvania with U.S. Armored TF PEACEMAKER near Eastern border crossings in the vicinity of 645815 or 639811. Organize Tank Platoon (reinf) with IBM and TACOM. Cooperate with NLOS provided by Hughes Training and LOSAT provided by TI and SAFDI from Raytheon.

2.3.08	Loral- ADS	ModSAF	SAF

LORAL ADS SAF Will provide 2 MI-24 Hind Helicopters, 4 T-72s and 4 BMPs to assault the border point in Scenario #1. They will create an OPFOR attack across the border near Eastern border crossings points in the vicinity of 645815 or 639811, depending on the suitability of the terrain.

2.3.09	IBM (FSC) CCTT IDT	M-1A2 Tank	Ground

Operate 1 M1A1 Tank in Bartsylvania with U.S. Armored TF PEACEMAKER near Eastern border crossings in the vicinity of 645815 or 639811. Organize Tank Platoon (reinf) with Martin Marietta and TACOM. Cooperate with NLOS provided by Hughes Training and LOSAT provided by TI and SAFDI from Raytheon.

2.3.10	Reflectone, Inc.	3 AH 64s 1 OH-58	Air

Operate 3 AH 64s and 1 OH58 to provide support to ground forces as required in border incursion by OPFOR units. Engage Tanks and BMPs with Cannon, Rockets, and HELLFIRE Missiles in Eastern zone in support of U. S. Armored TF PEACEMAKER near Eastern border crossings in the vicinity of 645815 or 639811.

2.3.11	ESL Inc.	DF System	Air (STEALTH,

Operate DF receiver onboard UH-60 (McDonnel Douglas) and UAVs (Veda and Hughes) and AH-1W (NAWC). Provide DF information and vector to network players on location of Ambassador with convoy.

2.3.12	Hughes Training	UAV (Team with ESL (Robert	Air

Operate UAV and provide a platform for a DF receivers onboard UH-60 (McDonnel Douglas) and UAVs (Veda and Hughes) and AH-1W (NAWC). Provide DF information and vector to network players. Fly racetrack course 15 k. long, East to West 1 K South and parallel to border from gridline 65 West (JOLON).

2.3.13	Technology Systems Inc	VOICE INTERCOM	Emissions (Voice

Operate Voice Intercom between units involved in DFing RF emissions. Provide radio to Ambassador with convoy.

Day #2 - Wednesday, 1 December 1993

.4.01	Lockheed Sanders	Patriot	Air Defense, Ground
berate Patriot Missile firing battery in Bartsylvania in the vicinity of 545785. Provide AD coverage thin zone as required against OPFOR SCUD and aircraft threats.			
.4.02	Lockheed Missiles & Space	SCUD TEL., Radar, Scud Missile,	Air Defense
berate SCUD Missile firing battery in Lilienthaliaia in the vicinity of 7799. Fire (2)SCUDs. Create SCUD unch sites and disperse site in real time. One firing will be as target for Patriot and one firing as target or THAAD. (NOTE: LMSC will create a FEWS satelite (Non-visual, No PDUs) for use in the THAAD play. ASC will shoot the THAAD. Lockheed Sanders will fire one Patriot.) Operate THAAD Missile firing ttery in Bartsylvania. Fire THAAD. Create THAAD Launch sites and disperse site in real time.			
.4.03	General Research Corporation	Threat Missile	Air Defense
berate Threat Missile firing battery in Lilienthalia in the vicinity of 265925. Provide AD coverage within ne as required against U. S. aircraft threats.			
.4.04	Coleman Research Corp.	SAM Missile	Air Defense, Air
ovide one SCUD Missile Launch from Lilienthalia vic 5495. Also provide a Patriot battery in rtsylvania which tracks and sucessfully engages (intercepts) the threat missile. In addition, provide ne SCUD launch which poses no threat to Bartsylvania. After this SCUD comes into radar track, the Booz llen TOC will alert the CRC Patriot launcher/TOC to disengage the threat (i.e. no interceptor will be fired ainst this threat). This SCUD will impact at an uninhabited, specified location.			
.4.05	McDonnell Douglas Training	F-15E	U.S. Air, F-15
Operate an F-15E in an anti-air and Anti-SCUD role in the Objective Area. Cooperate with X-31 and 130 if possible.			
.4.06	Kaman Sciences Corp.	Missile	Air
enario #2 - Operate Missile Frag model in cooperation with Patriot and Scud Missile Launchers to ovide a Missile Breakup Fragmentation Model.			
.4.07	Rockwell Space Division	X-31	Air
berate 1 X-31 in support of anti-air operation in Lilienthalia. Operate with F-15 in SCUD Search.			
.4.08	Hughes Training Inc.	JSTARS Aircraft	Air
Operate JSTARS Aircraft in Bartsylvania. Fly racetrack course 30 k. North to South parallel to coastline. osition TBD)			
.4.09	Booz. Allen & Hamilton, Inc.	Plan View	Non-Emitter (Plan View)
rovide an Air Defense Battalion Tactical Operations Center (TOC) to be used in conjunction with the leman Research simulations. BAH will transmit a TOC entity state PDUs and radio communication DUs. In scenario #1 the BAH TOC will receive a radio communication message from the Coleman Research simulation to track air threat entities. The BAH TOC will determine the threat TBM will not pact in an area of concern so a disengage message will be sent to the Coleman Simulation. Creating tity state for 3 trucks. Will send RF communications on the net.			

Day #2 - Wednesday, 1 December 1993

<table>
<tr><td>2.5.01</td><td>Lockheed Aeronautical Systems</td><td>C-130</td><td>Air</td></tr>
<tr><td colspan="4">Operate a C-130 in the Bartsylvania area. Demonstrate take off and landings from expeditionary airfield (Coordinates TBP). C-130 equipped with active emmitters conducts surveillance missions over Lilienthalia.</td></tr>
<tr><td>2.5.02</td><td>Lockheed, Ft Worth Company</td><td>CGF (2 MIG-29s)</td><td>SAF</td></tr>
<tr><td colspan="4">Operate 2 MIG-29s in "UN NO FLY ZONE". Engage F-16s over Lilienthalia. Operate CGF as required to generate SAM sites, Radars etc. as required.</td></tr>
<tr><td>2.5.03</td><td>Armstrong Laboratory</td><td>2 ea Mig 29s</td><td>Air</td></tr>
<tr><td colspan="4">The 2 AL/HRA F-16s will provide OPFOR air support in the guise of Mig 29s as required in this Scenario. The aircraft will be able to engage other aircraft with air-to-air missiles.</td></tr>
<tr><td>2.5.04</td><td>Lockheed, Ft Worth Company</td><td>1 F-16C</td><td>Air</td></tr>
<tr><td colspan="4">Operate 1 F-16 in CAS mission into Bartsylvania. Fly in 2 Plane formation with AFHRL. Provide CAS to U.S. Armor Units on border. Engage OPFOR with Mk82 bombs and Harms and Maverick missiles.</td></tr>
<tr><td>2.5.05</td><td>Lockheed, Ft Worth Company</td><td>1 F-16</td><td>Air</td></tr>
<tr><td colspan="4">Operate 1 F-16 in CAP mission into "UN NO FLY ZONE". Fly in 2 Plane formation with AFHRL. Engage MIG-29s over Lilienthalia. Air-to-Air Only.</td></tr>
<tr><td>2.5.06</td><td>Lockheed, Ft Worth Company</td><td>1 F-16</td><td>Air</td></tr>
<tr><td colspan="4">Operate 1 F-16 in CAP mission into "UN NO FLY ZONE". Fly in 2 Plane formation with AFHRL. Engage MIG-29s over Lilienthalia.</td></tr>
<tr><td>2.5.07</td><td>Encore Computers</td><td>MIG-29</td><td>Air</td></tr>
<tr><td colspan="4">Operate 1 MIG-29 in "UN NO FLY ZONE". Fly in 2 Plane formation with Motorola Computer Group / NTSC. Engage US aircraft in "UN NO FLY ZONE".</td></tr>
<tr><td>2.5.08</td><td>Motorola Computer Group /</td><td>Mig-29</td><td>Air</td></tr>
<tr><td colspan="4">Operate 1 MIG-29 in "UN NO FLY ZONE". Fly in 2 Plane formation with Encore Computers. Engage US aircraft in "UN NO FLY ZONE".</td></tr>
</table>

Day #2 - Wednesday, 1 December 1993

2.6.01	Lockheed Sanders	DIS Listener	Air Defense, Ground
O PDUs on Net, Listen only. No Scenario Play.			
6.02	Sogitec Industries	MESA (French Air Defense System)	Non-Emitter, Air
IO PDUs on Net, Listen only. No Scenario Play.			
6.03	IDA	STEALTH	Non-Emitter,(STEALTH)
IO PDUs on Net, Listen only.			
6.04	Raytheon Company, MSD	DIS Listener	Non-Emitter, DIS
O PDUs on Net, Listen only. No Scenario Play.			
2.6.05	TRW, MEAD	Plan View	Plan View
O PDUs on Net, Listen only. No Scenario Play.			
.6.06	Armstrong Laboratory	Gci station	Non-Emitter (Simulated
he AL/HRA Gci station will provide information on air intercepts to all networked USAF players. The GCI not an Emitter.			
2.6.07	Technology Systems, Inc.	DIS Listener	Non-Emitter,(STEALTH)
O PDUs on Net, Listen only. No Scenario Play.			
6.08	NAWC / TSD (NTSC)	STEALTH	Non-Emitter (STEALTH)
IO PDUs on Net, Listen only. No Scenario Play.			
6.09	ARPA (SAIC) WARBREAKER	STEALTH	Non-Emitter (STEALTH)
lo PDUs on the net.			
6.10	Armstrong Laboratory	Data Logger	Non-Emitter (Data
O PDUs on Net, Listen only. No Scenario Play.			
2.6.11	McDonnell Douglas Training	DIS Listener	Non-Emitter, (Plan
O PDUs on Net, Listen only. No Scenario Play.			
2.6.12	McDonnell Douglas Training	DIS Listener	Non-Emitter (Network
O PDUs on Net, Listen only. No Scenario Play.			
6.13	Mitre	DIS Listener	Non-Emitter (DIS
IO PDUs on Net, Listen only. No Scenario Play.			
6.14	Digital Equipment Corporation	STEALTH/ Plan View	Non-Emitter (STEALTH)
IO PDUs on Net, Listen only. No Scenario Play.			
6.15	McDonnell Douglas Training	Data Logger, Board Level Motorola	Non-Emitter (Data
O PDUs on Net, Listen only. No Scenario Play.			
.6.16	Army Personnel Research	CGF/PLAN VIEW/STEALTH	Non-Emitter (STEALTH)
O PDUs on Net, Listen only. No Scenario Play.			
.6.17	Concurrent Computer	Stealth , Data Logger, Monitor	Non-Emitter (Stealth ,
O PDUs on Net, Listen only. No Scenario Play.			
6.18	Silicon Graphics Inc.	STEALTH	Non-Emitter, (STEALTH)
IO PDUs on Net, Listen only. No Scenario Play.			
6.19	Lockheed Sanders	DIS Listener	CGF
O PDUs on Net, Listen only. No Scenario Play.			
6.20	Lockheed Sanders	DIS Listener	Ground
O PDUs on Net, Listen only. No Scenario Play.			
.6.21	Loral-ADS	Stealth	Non-Emitter (STEALTH)
O PDUs on Net, Listen only. No Scenario Play.			
.6.22	Loral-ADS	Stealth	Non-Emitter (STEALTH)
O PDUs on Net, Listen only. No Scenario Play.			

Day #3 - Thursday, 2 December 1993

3.1.01	Marconi	Submarine,TANGO Class	Sea, Subsurface

Operate hostile OPFOR Submarine off the coast of Lilienthalia in the "UN NO SAIL ZONE." Launch cruise missile at U.S. Forces ashore. "UN NO SAIL ZONE" includes any sea traffic in an area North of a point extending 200 Kilometers due West from the Lilienthalia / Bartsylvania border located 10 Kilometers North of Cape San Martin (387725) along the 83 grid line.

3.1.02	Paramax Systems Corporation	SAF, CGF	Sea, SAF

Create a OPFOR CG 47 off the coast of Lilienthalia in the "UN NO SAIL ZONE." Launch a SAM missile at F/A 18 aircraft.

3.1.03	NAWC / TSD (NTSC)	ship, carrier or frigate	Sea

Operate one CV in offshore maneuver area. Launch and receive V-22 aircraft.

3.1.04	Coleman Research Corp.	CG-47	Sea, Air

Operate one CG-47 off the coast of Bartsylvania. Sail in formation with CV. Launch AA Missile against OPFOR intruder Aircraft to protect CV.

3.1.05	FAAC-TRW	Surrogate Missile	Sea, Air Defense

Provide AD for the TRW Aegis Cruiser. Model emissions system (search radar for the ship and scan/acquisition, track and track/illumination for the fire control system) and engage multiple threats with a Standard missile model. FAAC will fire Sea Sparrow Missile(s) or Ship launched missile(s) at one or more incoming hostile aircraft, at one or more incoming air launched missile(s) (ASM), one or more incoming ground launched missile(s)(SSM), or at one or more incoming ship launched missile(s) (SSM).

3.1.06	TRW, Systems Integration Group	Aegis Cruiser	Sea, Air Defense

TRW will supply an AEGIS Cruiser and operate with the Carrier Battle Group. FAAC simulates the AEGIS Cruiser emission system and engages incoming threats (TBD) with a Standard Missile Model or with a with a Sea Sparrow Missile Model. Provides AD for the TRW Aegis Cruiser.

3.1.07	NSWC /Port Hueneme Div.	BFTT	Sea

Operate one Ship (FFG-12) in offshore maneuver area off the coast of Bartsylvania. Sail in formation with TRW Aegis Cruiser (CG-47) and NAWC TSD CV. Simulate the FFG emission system and engages incoming threats (TBD) with a Standard Missile Model. Provides AD for the CV.

3.1.08	Raytheon Company, MSD	Tomahawk Missile	Sea, Air

Operate TLAM from US Ship at Sea (BFTT FFG-12) against SILKWORM target located ashore in Lilienthalia (Coordinates TBD).

3.1.09	Digital Equipment Corporation	F/A 18	Air

Operate 1 F/A-18 in support of Advanced Force of the Surface Battle Group. Fly in 3Plane formation with NAWC/ TSD and Northrup ATDC Engage OPFOR aircraft in "UN NO SAIL ZONE".

3.1.10	Northrop Advanced Technology	F/A 18	U. S. Air, F/A 18,

Operate 1 F/A-18 in support of Advanced Force of the Surface Battle Group. Fly in 3 Plane formation with NAWC/ TSD and DEC. Engage OPFOR aircraft in "UN NO SAIL ZONE".

3.1.11	NAWC / TSD (NTSC)	F/A 18	Sea, Air, F/A 18

Operate 1 F/A-18 in support of Advanced Force of the Surface Battle Group. Fly in 3 Plane formation with NORTHRUP ATDC and DEC. Engage OPFOR aircraft in "UN NO SAIL ZONE".

3.1.12	VEDA, Inc.	E-2C	Air

Operate UAV and provide a platform for a DF receivers onboard UH-60 (McDonnel Douglas) and UAVs (Veda and Hughes) and AH-1W (NAWC). Provide DF information and vector to network players. Fly racetrack course 15 k. long, East to West 1 K South and parallel to border from gridline 65 East (JOLON).

3.1.13	NAWC/AC, Manned Flight	AH IW	Sea, Air, AH1W

Operate 1 AH-1W in the objective area. Provide CIFS and act as a FAC(A) to call air support for the British TF CHURCHILL or U. S. Ground Forces on the border or NEO OPS Convoy as required. Engage with Guns, 2.75" Rockets and TOW missiles as required.

3.1.14	NAWC/AD, Manned Flight	V-22	Sea, Air, V-22

Operate 1 V-22 from CV deck. (Icon modelled for vertical flight only.) Simulate vertical lift-off from CV and fly inland to airstrip and simulate the landing of supplies and troops and the evacuation of wounded.

3.1.15	Lockheed, Ft Worth Company	CGF	SAF

Operate 2 MIG-29s in "UN NO FLY ZONE". Engage ships in U.S. Battle Group with air-to-surface missiles. Engage F/A-18s with air-to-air missiles in "UN NO FLY ZONE".

Day #3 - Thursday, 2 December 1993

.2.01	MARCONI Simulation	Warrior ACV,	UK Ground, Warrior AFV

F CHURCHILL (TF CHURCHILL = DOAC, APRE, DRA and Marconi) will consist of 2 Challenger Tanks and Warrior AFVs reinforced with an Avenger (Boeing). Marconi Warrior will fire a TOW missile at ground or elo threats. TF CHURCHILL will be located in the vicinity of the Western Border crossing (Coord. 5982). They will repel an OPFOR attack across the border at 602837 or at 608829 depending on the suitability of e terrain. LORAL ADS SAF Will provide 2 SU-29s, 2 HIND MI-24 Helos, 2 T-72 Tanks and 4 BMPs to ssault the border point in Scenario #2.

3.2.02	Defense Research Agency	Warrior/ Challenger	UK, Ground

articipate in TF CHURCHILL. TF CHURCHILL (TF CHURCHILL = DOAC, APRE, DRA and Marconi) will onsist of 2 Challenger Tanks and 2 Warrior AFVs reinforced with an Avenger (Boeing). TF CHURCHILL will be located in the vicinity of the Western Border crossing (Coord. 5982). They will repel an OPFOR ttack across the border at 602837 or at 608829 depending on the suitability of the terrain. LORAL ADS AF Will provide 2 HIND MI-24 Helos and 2 BMPs to assault the border point.

3.2.03	Defense Operations Analysis	SAF	UK Ground

articipate in TF CHURCHILL. TF CHURCHILL (TF CHURCHILL = DOAC, APRE, DRA and Marconi) will onsist of 2 Challenger Tanks and 2 Warrior AFVs reinforced with an Avenger (Boeing). TF CHURCHILL ill be located in the vicinity of the Western Border crossing (Coord. 5982). They will repel an OPFOR attack across the border at 602837 or at 608829 depending on the suitability of the terrain. LORAL ADS AF Will provide 2 SU-29s, 2 HIND MI-24 Helos, 2 T-72 Tanks and 4 BMPs to assault the border point.

.2.04	Loral- ADS	ModSAF	SAF

ORAL ADS SAF Will provide 2 SU-29s, 2 HIND MI-24 Helos, 2 T-72 Tanks and 4 BMPs to assault the order point. They will create an OPFOR attack across the border at 602837 or at 608829 depending on the itability of the terrain.

3.2.05	Boeing Space and Defence	1 Avenger	Ground (Air Defense)

oeing will provide AD Support (Avenger) for British contingient. Boeing will locate the Avenger in the vic. f the high ground overlooking the Border at 575823. Boeing will fire on the 2 LORAL ADS SAF HIND MI-24 Helos assaulting the border point in. TF CHURCHILL will be located in the vicinity of the Western order crossing (Coord. 5982). They will repel an OPFOR attack across the border at 602837 or at 608829 epending on the suitability of the terrain. LORAL ADS SAF Will provide 2 SU-29s, 2 HIND MI-24 Helos, 2 T-72 Tanks and 4 BMPs to assault the border point.

2.06	CAE-Link	RAH-66 Commanche	Air, U.K. Ground

e CAE-Link RAH-66 "Commanche" helo will provide CIFS support for the British contingient. TF CHURCHILL will be located in the vicinity of the Western Border crossing (Coord. 5982). They will repel an PFOR attack across the border at 602837 or at 608829 depending on the suitability of the terrain. LORAL DS SAF Will provide 2 SU-29s, 2 HIND MI-24 Helos, 2 T-72 Tanks and 4 BMPs to assault the border oint.

Day #3 - Thursday, 2 December 1993

.3.01	SAIC	SAF	U. S. Ground
SAIC SAF will drive the civilian cars and Busses in the Non-Combatant Evacuation Convoy containing the J.S. Ambassador to Lilienthalia. The convoy consisting of 5 sedans, 6 buses, and 4 covered 6x6 Army rucks will be initially created in the vic of coord. 785845. The convoy may be moving or stopped due to oad blocks depending on the situation.			
3.3.02	Hughes Training	NLOS	U. S. Ground
)perate NLOS in Bartsylvania with U.S. Armored TF PEACEMAKER near border crossings in the vicinity of 645815 or 639811. Engage OPFOR Tanks and AFVs with NLOS from overwatch positions. Cooperate with LOSAT provided by TI and M1 Tanks from IBM, Martin Marietta and VP Tank from TACOM and SAFDI rom Raytheon.			
3.3.03	Texas Instruments	M2 BFV	U.S. Ground, M2 BFV
)perate 1 M2 BFV in Bartsylvania near Eastern border crossing point with U.S. Armored TF PEACEMAKER iear border crossings in the vicinity of 645815 or 639811. Organize Tank Platoon (reinf) with IBM, Martin Aarietta and TACOM. Cooperate with NLOS provided by Hughes Training and SAFDI provided by Raytheon. Engage OPFOR Tanks and AFVs from overwatch positions.			
.3.04	U. S. Army Tank Automotive	VP Tank	U. S. Ground
)perate 1 VP Tank in Bartsylvania with U.S. Armored TF PEACEMAKER near Eastern border crossings in he vicinity of 645815 or 639811. Organize Tank Platoon (reinf) with IBM, Martin Marietta and NLOS provided by Hughes Training and SAFDI provided by Raytheon. Engage OPFOR Tanks and AFVs from overwatch positions.			
3.3.05	Raytheon, Equipment Division	SAF DI	U.S. Ground SAF
)perate (IST developed) SAFDI in Bartsylvania with U.S. Armored TF PEACEMAKER near Eastern border crossings in the vicinity of 645815 or 639811. Provide OPFOR DI for border incursion. Provide DI firing dragon from border defensive positions at OPFOR vehicles.			
.3.06	McDonnell Douglas Training	UH-60	U.S. Air, Helo, UH-60
)perate DF receiver onboard UH-60. Cooperate with UAV (Veda and Hughes) and AH-1W (NAWC). Provide DF information and vector to network players. Simulate carrier landings if possible of MED EVAC SAFDI casualities.			
3.3.07	Martin Marietta	M1A2	U.S. Ground, M1A2
)perate 1 M1A2 Tank in Bartsylvania with U.S. Armored TF PEACEMAKER near Eastern border crossings n the vicinity of 645815 or 639811. Organize Tank Platoon (reinf) with IBM and TACOM. Cooperate with NLOS provided by Hughes Training and LOSAT provided by TI and SAFDI from Raytheon.			
.3.08	Loral- ADS	ModSAF	SAF
LORAL ADS SAF Will provide 4 Mig-29s, 2 MI-24 Hind Helicopters, 4 T-72s and 4 BMPs to assault the order point in Scenario #1. They will create an OPFOR attack across the border near Eastern border rossings points in the vicinity of 645815 or 639811, depending on the suitability of the terrain.			
.3.09	IBM (FSC) CCTT IDT	M-1A2 Tank	Ground
)perate 1 M1A1 Tank in Bartsylvania with U.S. Armored TF PEACEMAKER near Eastern border crossings n the vicinity of 645815 or 639811. Organize Tank Platoon (reinf) with Martin Marietta and TACOM. Cooperate with NLOS provided by Hughes Training and LOSAT provided by TI and SAFDI from Raytheon.			
.3.10	Reflectone, Inc.	3 AH 64s 1 OH-58	Air
)perate 3 AH 64s and 1 OH58 to provide support to ground forces as required in border incursion by)PFOR units. Engage Tanks and BMPs with Cannon, Rockets, and HELLFIRE Missiles in Eastern zone in upport of U. S. Armored TF PEACEMAKER near Eastern border crossings in the vicinity of 645815 or 39811.			
.3.11	ESL Inc.	DF System	Air (STEALTH,
)perate DF receiver onboard UH-60 (McDonnel Douglas) and UAVs (Veda and Hughes) and AH-1W NAWC). Provide DF information and vector to network players on location of Ambassador with convoy.			
.3.12	Hughes Training	UAV (Team with ESL (Robert	Air
)perate UAV and provide a platform for a DF receivers onboard UH-60 (McDonnel Douglas) and UAVs Veda and Hughes) and AH-1W (NAWC). Provide DF information and vector to network players. Fly acetrack course 15 k. long, East to West 1 K South and parallel to border from gridline 65 West (JOLON).			
.3.13	Technology Systems Inc	VOICE INTERCOM	Emissions (Voice
)perate Voice Intercom between units involved in DFing RF emissions. Provide radio to Ambassador with			

Day #3 - Thursday, 2 December 1993

<table>
<tr><td>.4.01</td><td>Lockheed Sanders</td><td>Patriot</td><td>Air Defense, Ground</td></tr>
<tr><td colspan="4">perate Patriot Missile firing battery in Bartsylvania in the vicinity of 545785. Provide AD coverage within ne as required against OPFOR SCUD and aircraft threats.</td></tr>
<tr><td>.4.02</td><td>Lockheed Missiles & Space</td><td>SCUD TEL., Radar, Scud Missile,</td><td>Air Defense</td></tr>
<tr><td colspan="4">perate SCUD Missile firing battery in Lilienthaliaia in the vicinity of 7799. Fire (2)SCUDs. Create SCUD unch sites and disperse site in real time. One firing will be as target for Patriot and one firing as target or THAAD. (NOTE: LMSC will create a FEWS satelite (Non-visual, No PDUs) for use in the THAAD play. MSC will shoot the THAAD. Lockheed Sanders will fire one Patriot.) Operate THAAD Missile firing ttery in Bartsylvania. Fire THAAD. Create THAAD Launch sites and disperse site in real time.</td></tr>
<tr><td>.4.03</td><td>General Research Corporation</td><td>Threat Missile</td><td>Air Defense</td></tr>
<tr><td colspan="4">perate Threat Missile firing battery in Lilienthalia in the vicinity of 265925. Provide AD coverage within ne as required against U. S. aircraft threats.</td></tr>
<tr><td>.4.04</td><td>Coleman Research Corp.</td><td>SAM Missile</td><td>Air Defense, Air</td></tr>
<tr><td colspan="4">rovide one SCUD Missile Launch from Lilienthalia vic 5495. Also provide a Patriot battery in rtsylvania which tracks and sucessfully engages (intercepts) the threat missile. In addition, provide ne SCUD launch which poses no threat to Bartsylvania. After this SCUD comes into radar track, the Booz llen TOC will alert the CRC Patriot launcher/TOC to disengage the threat (i.e. no interceptor will be fired ainst this threat). This SCUD will impact at an uninhabited, specified location.</td></tr>
<tr><td>.4.05</td><td>McDonnell Douglas Training</td><td>F-15E</td><td>U.S. Air, F-15</td></tr>
<tr><td colspan="4">erate an F-15E in an anti-air and Anti-SCUD role in the Objective Area. Cooperate with X-31 and C-130 possible.</td></tr>
<tr><td>.4.06</td><td>Kaman Sciences Corp.</td><td>Missile</td><td>Air</td></tr>
<tr><td colspan="4">erate Missile Frag model in cooperation with Patriot and Scud Missile Launchers to provide a Missile eakup Fragmentation Model.</td></tr>
<tr><td>.4.07</td><td>Rockwell Space Division</td><td>X-31</td><td>Air</td></tr>
<tr><td colspan="4">erate 1 X-31 in support of anti-air operations in Lilienthalia. Operate with F-15 in SCUD Search.</td></tr>
<tr><td>.4.08</td><td>Hughes Training Inc.</td><td>JSTARS Aircraft</td><td>Air</td></tr>
<tr><td colspan="4">erate JSTARS Aircraft in Bartsylvania. Fly racetrack course 30 k. North to South parallel to coastline. sition TBD).</td></tr>
<tr><td>.4.09</td><td>Booz. Allen & Hamilton, Inc.</td><td>Plan View</td><td>Non-Emitter (Plan View)</td></tr>
<tr><td colspan="4">ovide an Air Defense Battalion Tactical Operations Center (TOC) to be used in conjunction with the leman Research simulations. BAH will transmit a TOC entity state PDUs and radio communication DUs. In scenario #1 the BAH TOC will receive a radio communication message from the Coleman esearch simulation to track air threat entities. The BAH TOC will determine the threat TBM will not pact in an area of concern so a disengage message will be sent to the Coleman Simulation. Creating ity state for 3 trucks. Will send RF communications on the net.</td></tr>
</table>

Day #3 - Thursday, 2 December 1993

3.5.01	Lockheed Aeronautical Systems	C-130	Air
Operate a C-130 in the Bartsylvania area. Demonstrate take off and landings from expeditionary airfield (Coordinates TBP). C-130 equipped with active emmitters conducts surveillance missions over Lilienthalia.			
3.5.02	Lockheed, Ft Worth Company	CGF (2 MIG-29s)	SAF
Operate 2 MIG-29s in "UN NO FLY ZONE". Engage F-16s over Lilienthalia. Operate CGF as required to generate SAM sites, Radars etc. as required.			
3.5.03	Armstrong Laboratory	2 ea F-16s	Air
The 2 AL/HRA F-16s will provide air support as required in this Scenario. The F-16s will be able to engage other aircraft with air-to-air missiles.			
3.5.04	Lockheed, Ft Worth Company	1 F-16C	Air
Operate 1 F-16 in CAP mission into "UN NO FLY ZONE". Fly in 2 Plane formation with Motorola Computer Group / NTSC. Engage MIG-29s over Lilienthalia. Can Drop Mk82 bombs and HARMS and Maverick missiles.			
3.5.05	Lockheed, Ft Worth Company	1 F-16	Air
Operate 1 F-16 in CAP mission into "UN NO FLY ZONE". Fly in 2 Plane formation with AFHRL. Engage MIG-29s over Lilienthalia. Air-to-Air Only.			
3.5.06	Lockheed, Ft Worth Company	1 F-16	Air
Operate 1 F-16 in CAP mission into "UN NO FLY ZONE". Fly in 2 Plane formation with AFHRL. Engage MIG-29s over Lilienthalia.			
3.5.07	Encore Computers	MIG-29	Air
Operate 1 MIG-29 in "UN NO FLY ZONE". Fly in 2 Plane formation with Motorola Computer Group / NTSC. Engage US aircraft in "UN NO FLY ZONE".			
3.5.08	Motorola Computer Group /	Mig-29	Air
Operate 1 MIG-29 in "UN NO FLY ZONE". Fly in 2 Plane formation with Encore Computers. Engage US aircraft in "UN NO FLY ZONE".			

Day #3 - Thursday, 2 December 1993

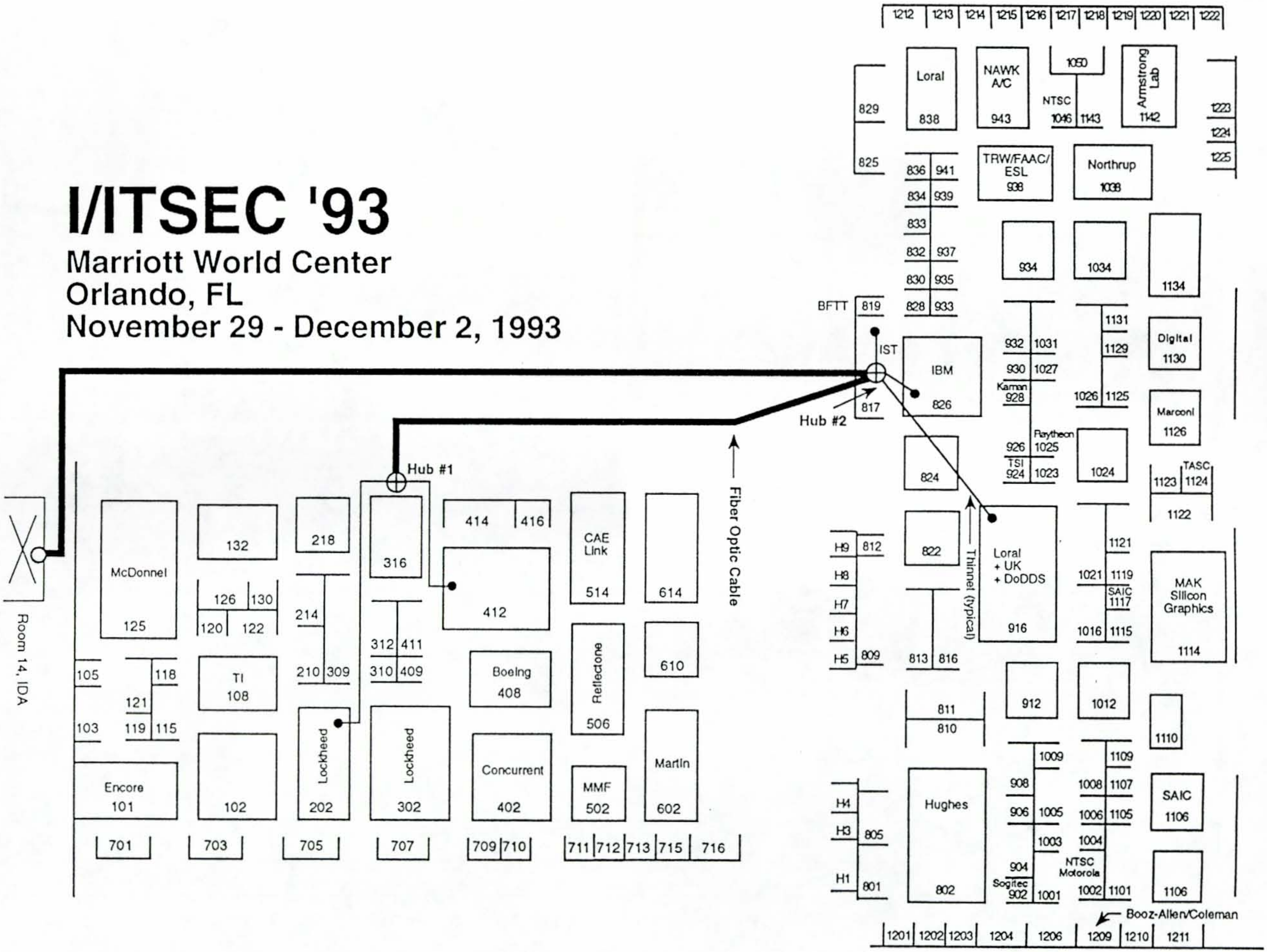
.6.01	Lockheed Sanders	DIS Listener	Air Defense, Ground
O PDUs on Net, Listen only. No Scenario Play.			
6.02	Sogitec Industries	MESA (French Air Defense System)	Non-Emitter, Air
IO PDUs on Net, Listen only. No Scenario Play.			
6.03	IDA	STEALTH	Non-Emitter,(STEALTH)
IO PDUs on Net, Listen only.			
6.04	Raytheon Company, MSD	DIS Listener	Non-Emitter, DIS
O PDUs on Net, Listen only. No Scenario Play.			
6.05	TRW, MEAD	Plan View	Plan View
O PDUs on Net, Listen only. No Scenario Play.			
.6.06	Armstrong Laboratory	Gci station	Non-Emitter (Simulated
O PDUs on Net, Listen only. No Scenario Play.The AL/HRA Gci station will provide information on air tercepts to all networked USAF players. The GCI is not an Emitter.			
.6.07	Technology Systems, Inc.	DIS Listener	Non-Emitter, (STEALTH)
O PDUs on Net, Listen only. No Scenario Play.			
.6.08	NAWC / TSD (NTSC)	STEALTH	Non-Emitter (STEALTH)
O PDUs on Net, Listen only. No Scenario Play.			
6.09	ARPA (SAIC) WARBREAKER	STEALTH	Non-Emitter (STEALTH)
lo PDUs on the net.			
6.10	Armstrong Laboratory	Data Logger	Non-Emitter (Data
ATA Logger only. No PDUs on the net.			
6.11	McDonnell Douglas Training	DIS Listener	Non-Emitter, (Plan
O PDUs on Net, Listen only. No Scenario Play.			
.6.12	McDonnell Douglas Training	DIS Listener	Non-Emitter (Network
O PDUs on Net, Listen only. No Scenario Play.			
.6.13	Mitre	DIS Listener	Non-Emitter (DIS
O PDUs on Net, Listen only. No Scenario Play.			
.6.14	Digital Equipment Corporation	STEALTH/ Plan View	Non-Emitter (STEALTH)
IO PDUs on Net, Listen only. No Scenario Play.			
6.15	McDonnell Douglas Training	Data Logger, Board Level Motorola	Non-Emitter (Data
IO PDUs on Net, Listen only. No Scenario Play.			
6.16	Army Personnel Research	CGF/PLAN VIEW/STEALTH	Non-Emitter (STEALTH)
O PDUs on Net, Listen only. No Scenario Play.			
6.17	Concurrent Computer	Stealth , Data Logger, Monitor	Non-Emitter (Stealth ,
PDUs on the net.			
.6.18	Silicon Graphics Inc.	STEALTH	Non-Emitter, (STEALTH)
O PDUs on Net, Listen only. No Scenario Play.			
.6.19	Lockheed Sanders	DIS Listener	CGF
O PDUs on Net, Listen only. No Scenario Play.			
6.20	Lockheed Sanders	DIS Listener	Ground
IO PDUs on Net, Listen only. No Scenario Play.			
6.21	Loral-ADS	Stealth	Non-Emitter (STEALTH)
IO PDUs on Net, Listen only. No Scenario Play.			
6.22	Loral-ADS	Stealth	Non-Emitter (STEALTH)
O PDUs on Net, Listen only. No Scenario Play. (No Air-to-Ground)			

Appendix 10

Demonstration Facility Schematic

I/ITSEC '93

Marriott World Center
Orlando, FL
November 29 - December 2, 1993



0610-6298

Appendix 11

Participant Questionnaire

I/ITSEC '93 DIS DEMONSTRATION QUESTIONNAIRE

This questionnaire is intended to improve the quality of future large scale demonstrations and experiments involving DIS. Our intention is to review the entire process of creating a large scale demonstration or experiment focusing on interoperability and DIS. IST will use the results of this survey to improve the quality of future interoperability demonstrations.

We would like inputs only from those who were directly involved in the planning or execution of the final demonstration. **Responses to this questionnaire can be anonymous.** IST will protect the identity of anyone wishing to put their name on the questionnaire. **One input per participating organization, please.** Large organizations who had multiple divisions participating in the demonstration may respond on a division basis. Inputs may be provided to IST via e-mail (goldiez@ucf1vm.cc.ucf.edu), fax (407-658-5059, ATTENTION: GOLDIEZ), or via mail addressed to:

Institute for Simulation and Training
ATTENTION: Brian Goldiez
3280 Progress Drive
Orlando, FL 32826

IST will distribute results to all participants via the final report published on the demonstration and make distribution to as wide an audience as practical. Responses can be sent at any time, however, IST will accumulate all data received by the close of business on January 10, 1994 for initial processing and input to a Progress Review held for STRICOM and DMSO on January 13, 1994 and for the I/ITSEC '94 Planning Meeting on January 20, 1994.

The following scale should be used to respond to appropriate questions:

A. STRONGLY AGREE
B. SOMEWHAT AGREE
C. NEUTRAL OR NOT APPLICABLE
D. SOMEWHAT DISAGREE
E. STRONGLY DISAGREE

Those questions requiring a **YES** or **NO** can be amplified if desired.

---

1. The monthly planning meetings should be: __
   - A) Increased in frequency------------0
   - B) Decreased in frequency----------- 2
   - C) Eliminated--------------------------0
   - D) Held at the current frequency----19

2. The technical content of the monthly meetings is appropriate. __

A	B	C	D	E
4	9	4	4	0

3. The DIS test procedures used for the I/ITSEC are appropriate with respect to scope. __

A	B	C	D	E
2	6	2	8	2

4. The deadlines created for the demonstration should be: __
   - A) More tightly enforced----------------------16
   - B) OK as currently implemented--------------5
   - C) Relaxed more.-------------------------------0

5. All systems were DIS tested in a consistent manner. __

A	B	C	D	E
2	1	7	6	4

6. IST's testing prior to I/ITSEC should be continued. __

A	B	C	D	E
18	2	0	1	0

7. Methods to access IST for testing are adequate (i.e., bring simulator to IST, use 1-800 service, send disk to IST). __

A	B	C	D	E
7	7	3	4	0

8. Data base correlation tests were adequate. __

A	B	C	D	E
0	3	8	6	3

9. All systems were correlation tested consistently. __

A	B	C	D	E
2	0	9	5	4

10. All test results were timely. __

A	B	C	D	E
5	7	2	4	3

11. Scenarios were well defined. __

A	B	C	D	E
0	2	3	4	12

12. Scenarios were defined in a timely manner. __

A	B	C	D	E
0	1	2	8	10

13. The demonstration content was appropriate for the large audience._

A	B	C	D	E
1	4	3	5	8

14. The time allowed for rehearsal was too long. __

A	B	C	D	E
1	2	4	7	6

15. The demonstration content in individual booths was appropriate. __

A	B	C	D	E
2	6	7	4	2

16. The use of the network for experimentation was adequate. __

A	B	C	D	E
4	9	6	1	1

17. Performance of the physical network was adequate. __

A	B	C	D	E
8	11	1	1	0

18. Performance of the software layers of the network was adequate.

A	B	C	D	E
5	7	5	2	1

19. Resolution of problems was timely. __

A	B	C	D	E
1	4	5	5	6

20. Resolution of problems was equitable. __

A	B	C	D	E
2	8	4	3	4

21. The roles of all participants was well defined. __

A	B	C	D	E
0	5	3	5	7

22. The format of the demonstrations is appropriate. __

A	B	C	D	E
1	2	4	5	9

23. Participant recognition was appropriate. __

A	B	C	D	E
4	4	3	6	3

24. IST kept participants informed of activities, decisions, meetings, etc. in a timely manner. __

A	B	C	D	E
4	8	4	4	1

25. Group decisions were adhered to by participants. __

A	B	C	D	E
4	8	4	4	1

26. I would encourage my organization to participate in another DIS demonstration. __

A	B	C	D	E
10	4	3	2	2

27. I believe that the version of DIS used at I/ITSEC (DIS 2.0.4) is sufficiently stable and error free to be approved by the IEEE. __

A	B	C	D	E
3	8	3	6	1

28. Additional conference settings should be sought to demonstrate DIS.

A	B	C	D	E
3	8	6	0	4